THE IRON TRADE REVIEW

XXXI. CLEVELAND, O. DECEMBER 29. 1898. CHICAGO, ILL. NUMBER 52

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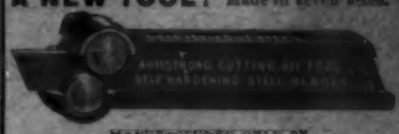

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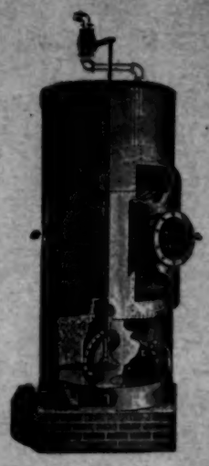

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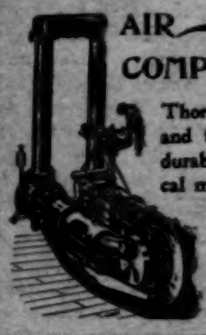

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THE IRON TRADE REVIEW

VOLUME XXXI. CLEVELAND, O. DECEMBER 29, 1898. CHICAGO, ILL. NUMBER 52

THE WEEK IN IRON CIRCLES.

THE MARKET AT LARGE.

Actual selling has been at a somewhat lessened pace in the iron market the past week. chiefly because many furnaces are oversold for the first half of the new year, and most of the large buyers have made their contracts. It has been a December of unparalleled activity, the strength of the situation rather increasing as the end of the year approaches; and to-day there is nowhere an indication that the height of the movement has been reached. Instead of looking for the usual holiday signs of weakness the trade is interested in knowing where the next advances will come and how far the new record for tonnage that is expected for 1899 will carry them. Pronounced conservatism is in control and the absence of a general upward movement in prices, taking in every form of finished product is remarkable. Movements in the consolidations have attracted attention in the week, particularly in American Steel & Wire. Options have been taken by the latter on three large companies and a fourth has been bought out. The closing of the deal is expected within the next three weeks, as detailed elsewhere. Meanwhile the common stock of the big company has gone up strongly. The deal, if carried through, insures it a large part of its billet supply and seems to dispose, for the time, at least, of any talk of incorporation in the Federal Steel Co. The American Tin Plate Co.'s policy is discussed, also, the two consolidations indicating plainly a concentration of the production of rod billets and tin bars upon a few steel plants. The trade is interested in determining on what lines the readjustment of the business in billets and sheet and tin plate bars will be made, rather than concerned about the mills that have no consuming connections; for there seems no question of the full employment of all the Bessemer and basic steel capacity at the present rate of consumption. The steel plants of the Central West are now well sold up for several months in 1899, and the feeling is very firm. Steel billets have advanced to $16.25 maker's mill Pittsburg, with little steel to be had for the first quarter of the year. Holiday repairs at some plants have accented this situation. Rods, likewise, are difficult to get for early delivery and are now quoted at $22, Pittsburg and Cleveland. There is a shortage of rods for Western delivery and shipments have been made recently from the Central West to the Chicago district. The Bessemer pig iron market is firm at $10.25 to $10.50 valley furnace, and there is little disposition to quote for the first quarter of 1899. In foundry iron the position of producers has been strengthened in all markets in the past week. Some furnaces have withdrawn from the market for the present, and there are intimations that a further slight advance will be announced at the turn of the year. Gray forge is also higher under the continued strong demand for basic material. Northern furnaces are yet in ignorance of the cost of their 1899 ores. No agreement has been reached on non-Bessemer ores, and it is not certain that the elements can be harmonized, but it is believed that advances in mine labor and in lake freights will add from 35 to 50 cents a ton to the cost of Northern pig iron. There is no end of rail buying, Chicago reporting 80,000 tons closed there the past week, most of it going to the mills in the Western agreement. The 80,000 tons recently closed for Russia, added to 35,000 tons for Australia, all to be rolled in the East, indicates that foreign business is to be had for the going after. The plate mills are quoting $1 to $2 a ton higher than two weeks ago, 1.25c Pittsburg being the usual minimum. Some of them are out of the market and others are quoting only to regular trade. One Pittsburg producer is full for the first quarter, between Australian, Eastern shipyard and steel car contracts. Sheets are $1 to $2 a ton higher and it remains to be seen what further advance will come from the action of the manufacturers' committee appointed at Pittsburg. Bars are unchanged in price, but December contracts were never so large. Tin plate prices are not yet announced.

PITTSBURG.

OFFICE OF *The Iron Trade Review and Industrial World.*
705 PUBLICATION BUILDING, Dec. 28.

There has been in the week a slackening of the activity in the iron and steel market. This seems to have been due wholly to the holiday, and the condition is still one of very unusual strength. In both raw and finished material there has been an abundance of inquiry, resulting in moderate sales, while prices all along the line are firmer, and in some branches decided advances have been made. The export inquiry continues to be an interesting feature of the trade.

PIG IRON.—In Bessemer there has been an active demand, but the valley furnacemen have been unwilling to sell further to any great extent, and have for most inquiries put up the price to $10 50, with a view, it is believed, of shutting off sales, as the furnaces are well sold up for some time. There have been moderate sales on the basis of $10.75, Pittsburg, although somewhat higher prices than this have been quoted. In mill and foundry irons there has been considerable activity all along the line, and furnaces which put up their asking price some time ago are now getting the advance. No. 2 foundry can scarcely be had under $10 50, at which price sales are reported. Mill iron has been quite active, especially in the valley, $9.30 representing the minimum there, while $9.75 has been obtained in the local market. The outloook is very strong in both foundry and gray forge. We quote:

Bessemer, valley furnace	$10.25 to $10.50
Bessemer, Pittsburg	10.75 to 10.90
No. 1 Foundry	11.10 to 11.30
No. 2 Foundry	10.50 to 10.60
No. 3 Foundry	10.00 to 10.10
Gray Forge, valley furnace	9.30 to 9.50
Gray Forge, Pittsburg	9.75 to 9.80

BILLETS AND RODS.—Billets are still stronger than at last report in view of further urgent inquiry with the mills already comfortably filled. Occasional sales have been reported as high as $16.50, which does not, however, represent the market. Nothing below $16.25, Pittsburg mill, could be done. A sale of 1,000 tons, January, February and March, is reported at $16.30, maker's mill. The sheet bar market is still nominal, as the sheet trade has not been buying and the tin plate combination has not come into the market. It is regarded as certain that some arrangement has been made, either for the whole output of two mills, or for an allotment of the tonnage among all, but as far as can be learned the trade has nothing but conjecture on which to base these views. Sheet bars are scarce and deliveries are difficult to secure on contracts. Wire rods are firm at $21.50 to $22.

PLATES.—The plate market continues very firm with a moderate tonnage being booked. It would not be so easy as last week to place orders under a cent and a quarter. We still quote: Tank, 1.20c to 1.25c; shell, 1.30c; flange, 1.35c; fire-box, 2c and upward.

SHEETS.—The sheet trade is losing much of the weakness of a month ago, and may become quite strong should sheet bars follow the course of billets. Nothing below 1.90c for No. 28 common can now be done for the first quarter of next year and sales are reported up to 1.95c, while some mills have quoted as high as 2c. Some mystery attaches to the committee of three appointed at the last meeting of the sheet makers in connection with the market, as even the personnel of this committee is not given out for publication, and it may be that something of importance may be done. It is conjectured that this committee may have been instructed to negotiate with the tin plate consolidation in connection with the manufacture of light sheets by the combine. Heretofore the manufactures of this class of sheet by the individual tin plate makers has seriously affected the trade of the regular sheet manufacturers, but they were powerless to do anything to regulate the matter.

SPELTER.—The spelter market has eased off considerably, and the metal may now be secured at about 5c, Pittsburg, St. Louis quoting about 4.90c.

IRON AND STEEL SKELP.—The general marking up of values has affected the skelp trade, in connection with an active demand, and we quote iron skelp, both grooved and sheared, at an advance of 2½ cents a hundred, and sheared steel skelp at an advance of 5 cents a hundred, as follows: Grooved iron skelp, 1.07½c to 1.10c; sheared iron skelp, 1.20 to 1.22½; grooved steel skelp, 97½c to 1.05c; sheared steel skelp, 1.15c to 1.17½c.

FERRO-MANGANESE AND SPIEGEL.—These lines continue unaltered, 80 per cent domestic ferro being quoted at $50, and spiegel at $23.50 to $24.00

RAILS AND TRACK MATERIAL.—There is little doing in rails at the present time, and while prices are open to competition, the strength in the billet market, which is largely due to the heavy selling recently in the rail market, has reacted on the latter, and the mills are holding out for fair prices of their own accord. We quote $17 to $18, Pittsburg, for standard sections. In track material there is no change beyond the advance in links and pins noted last week. We quote Spikes, 1.45c; track bolts, 1.65c to 1.70c; splice bars, 1.10c to 1.15c; links and pins are quoted from 1.30c to 1.35c.

PIPES AND TUBES.—The pipe mills are well filled with orders with which to begin the new year, and prices are quoted as without any change, as follows. Additional discounts, six tens for less than car load lots, and six tens and five for car loads; base discounts: Butt weld, black, 55 per cent off; lap weld, black, 65 per cent off; butt weld, galvanized, 47½ per cent off; lap weld, galvanized, 52½ per cent off. Discounts on merchant boiler tubes are as follows: 2¼-inch and smaller, 72½ per cent off; 2½ inch and larger, 75 per cent off. Inserted joint casing is quoted at 60 off and screw and socket joint casing at 60 and 10 per cent off.

STRUCTURAL MATERIAL.—There is a continued small demand for structural material but nothing large is in sight, or would be expected at this time. The schedule of prices remains unchanged, as follows: Beams and channels, 3 to 15 inches, 1.20c; 18 to 24 inches, 1.30c; tees, 1.25c; zees, 1.20c, and angles, 1.10c.

OLD MATERIAL.—Old steel rails and melting scrap are much stronger, otherwise there is no important change. We quote: Old steel rails, long lengths, $10.25, cut, $10.75; old iron rails, $14; wrought iron scrap, $11.50, net valley; cast borings, $6; busheling scrap, $9, net; car wheels, $10.25, gross; cast scrap, $9, gross; iron axles, $6, net; steel axles, $12.50, gross; charcoal scrap, $10, gross; wrought turnings, $6.75, net, valley.

CHICAGO.

OFFICE OF *The Iron Trade Review and Industrial World.*
1522 MONADNOCK BLOCK, Dec. 28.

Every branch of the market was active last week. Sales of iron and steel were large, and the demand indicates considerable sales for the next few weeks. Prices are firm, and absolutely no concessions are made to secure business. Mills and furnaces are all full of orders, and some of them have withdrawn from the market for the present.

PIG IRON.—Sales last week were fully as large as those of the week previous, and included several orders of considerable tonnage. There was a large demand for both Northern and Southern irons, and Lake Superior charcoal. Of the latter a heavy tonnage was sold. The furnaces are all exceedingly firm in their views, and further advances in prices are looked for to be made in the immediate future. The local furnaces are talking of making advances this week, and may do so. The larger Southern furnaces have withdrawn from the market for the present on all grades, having sold their output for several months ahead. As a matter of fact, there is very little iron of any kind for sale, for delivery within the next three months. The present situation, in the local market, at least, more nearly approaches a shortage than any for a very long time past. As a consequence the market is exceedingly firm, and is more than likely to remain so. Buyers are using their iron rapidly, taking it in as fast as the furnaces can make shipments. The consumption of iron in this territory is larger than ever before, and shows no signs of growing smaller within the next six months. Quotations are unchanged as follows:

Lake Sup. Charcoal	$11 50 @ $13 00	Southern Coke No. 3	$10 60 @ 10 85
Local Coke Fdy. No. 1	11 50 @ 12 00	Southern No. 1 Soft	11 10 @ 11 35
Local Coke Fdy. No. 2	11 00 @ 11 50	Southern No. 2 Soft	10 85 @ 11 10
Local Coke Fdy. No. 3	10 75 @ 11 00	Southern Silveries	11 75 @ 12 25
Local Scotch Fdy. No. 1	11 50 @ 12 00	Jackson Co. Silveries	12 50 @ 14 50
Local Scotch Fdy. No. 2	11 00 @ 11 50	Ohio Strong Softeners	12 00 @ 12 50
Local Scotch Fdy. No. 3	10 75 @ 11 00	Alabama Car Wheel	15 00 @ 16 00
Southern Coke No. 1	11 10 @ 11 35	Malleable Bessemer	11 00 @ 12 00
Southern Coke No. 2	10 85 @ 11 10	Coke Bessemer	11 00 @ 12 00

BARS.—While some evidence is shown of weakness on the part of a few mills, the market generally is stronger than a week ago, and most of the business being placed is at slightly higher prices. Considerable sales were made last week, the orders including one of 4,000 tons. Common iron is selling at from 1.02½c to 1.10c; guaranteed, 1.05c to 1.15c; billet stock steel, 1.05c to 1.15c.

RAILS AND TRACK SUPPLIES.—Sales of over 80,000 tons of rails were made in this market last week, only about 10,000 tons of which were made by the local mills. By far the larger part of the remainder were sold by mills in the agreement. Light rails are in good demand, and quite large sales were made. Quotations are made as follows: Standard section rails, $18 to $19; light rails, $20 and upwards; steel splice bars, 1.15c to 1.25c; track bolts with square nuts, 1.80c to 1.90c; hexagon nuts, 1.90c to 2c; spikes, 1.55c to 1.60c.

BILLETS AND RODS.—The inability of the mills to take further orders caused a quiet market last week, although there were considerable inquiries for both billets and rods. Billets are quoted at $17.50, and rods at $22.50.

CAR ORDERS.—No large contracts were placed last week for cars, but a good many small orders were given out, and further business is in prospect for the immediate future. The Wabash road is understood to be in the market for 1,200 cars. Car material was in heavy demand, and large sales were made.

STRUCTURAL MATERIAL.—No large contracts were placed last week, but general business was remarkably good, considering the season of the year. Good sales of nearly all kinds of material were made last week, and the demand for small lots appears to be increasing. Quotations are as follows: Beams, 15 inch and under, 1.35c to 1.40c; 18-inch and over, 1.45c to 1.50c; angles, 1.25c to 1.30c; plates, 1.25c to 1.40c; tees, 1.40c to 1.45c; zees, 1.35c to 1.40c. Small lots from stock are quoted at ¼c to ½c higher.

PLATES.—Business last week was large, including orders for over 5,000 tons secured by the local mills. The demand is very heavy, and sales will continue. Quotations are as follows: Tank plates, 1.30c to 1.40c; flange steel, 1.35c to 1.45c; firebox steel, 1.85c to 5c.

SHEETS.—Sales of black sheets last week were especially large, including one contract for over 4,000 tons. General business was very good, and dealers are expecting a continuance of the demand. Galvanized sheets did not sell so well, although good sales were made. Quotations are made at 2c to 2.10c for black sheets, and 80 and 7½ per cent off for galvanized.

MERCHANT STEEL.—The mills are crowded with business, and can accept very few orders for anything like immediate shipment. The demand is large, and shows no signs of decreasing. Quotations follow: Open-hearth spring, tire and machinery steel, 1.65c to 1.75c; smooth finished machinery steel, 1.60c to 1.70c; smooth finished tire, 1.50c to 1.60c; tool steel, 5.50c to 7.50c; specials, 11c and upwards.

SCRAP.—No very large business was done last week, although

there were quite good sales of old steel rails. Remelting steel scrap is in good demand. Dealer's selling quotations are as follows:

Old iron rails, gross	$13 00@$13 50	Axles, net	$14 50@$15 00
Old steel rails, long, gr.	10 50@ 11 00	Cast borings, net	4 25@ 4 50
Old steel rails, short	8 75@ 9 00	Wrought turnings, net	6 00@ 6 50
Old wheels, gross	11 50@ 11 75	Axle turnings, net	7 00@ 7 25
Railroad forge, net	11 50@ 12 00	Mixed steel, gross	7 45@ 7 50
Dealer's forge, net	10 00@ 10 50	Stove plates, net	5 75@ 6 00
No. 1 mill, net	8 50@ 8 75	Heavy melting steel, gr.	8 25@ 8 50
Heavy cast, net	8 50@ 9 00	Old iron splice b., net.	12 75@13 00
Malleable cast, net	8 00@ 8 50		

CLEVELAND.

OFFICE OF *The Iron Trade Review and Industrial World.*
27 VINCENT ST., Dec. 28.

Another meeting of the producers of non-Bessemer Lake Superior ores is appointed for to-day, an adjournment being taken from last week on account of the absence of certain sellers. The diversity of interests involved; the varying strength of the producers; the fact that some are fee-owners and others are lessees; identification of some companies with railroad property which must handle a large tonnage; the greater necessity upon some producers than others of disposing of their full output—all these considerations are involved in any attempt to agree. Failure to make a price has been predicted on the strength of some developments, one of which is the ore already sold. Opinions differ as to the size of the advance that will be made in lake freights. The vessels now building that will be ready in the first month or two of the navigation season are very few, and represent a small tonnage compared with that lost in storms the past season or bought for transfer to the Atlantic coast trade.

Later.—The result of the meeting to-day (Wednesday) makes it certain that there will be no association of producers of non-Bessemer ores for 1899. Agreement upon a price basis is found to be impossible.

PIG IRON.—The market for Bessemer continues very strong. The prospective addition of further capacity in the Pittsburg district, in the Mahoning valley and the Lorain district is as yet too remote in the case of most of the new or proposed furnaces to figure in present calculations of the Bessemer furnacemen. There is no quotation out on Bessemer, but $10.25 valley and $10.90 are the highest actual prices realized thus far. The consumption is surprisingly large but holiday shutdowns at some of the steel plants will reduce this. Sellers of foundry grades are firmer; those easiest in prices are filling up and $9.75 in the valley for No. 2 is the general minimum. Sales are being made steadily, and the possibility of a further advance by Southern sellers is stiffening some furnaces to valley quotations of $10.50 and $10 on No. 1 and No. 2 respectively. Forge iron is strong at $9.25 to $9.50 valley furnace, the large call for basic affecting mill iron also. Southern is still quoted $9.90 at valley mill, with little to be had for the first quarter. Valley-Pittsburg freight rates will be more rigidly held, it is reported, after Jan. 1. We quote f. o. b. Cleveland:

Bessemer	10 75	Valley Scotch No. 1	$10 65@10 90
No. 1 Strong Foundry	10 65@10 75	Valley Scotch No. 2	10 25@10 40
No. 2 Strong Foundry	10 25@10 40	Gray Forge	9 90
No. 3 Foundry	10 00	Lake Superior Charcoal	11 50

BILLETS AND RODS.—Contracts for billets for a portion of the local rod mill capacity would come up soon in the ordinary course of trade, but the outcome of the pending negotiations for the acquisition of the Cleveland Rolling Mill Co.'s plant by the American Steel & Wire Co. will probably be awaited. The options run for three weeks yet. We quote billets at $16 and rods at $22, with none of the latter to be had from local sellers. Some shipments of rods have been made from this district lately to the Chicago district.

FINISHED MATERIAL.—Business in structural material aggregating 1,500 tons has been closed in the past week. No special activity is noted in other lines. Plates cannot be delivered short of three months by some mills, the Australian work and steel cars, added to Eastern vessel contracts, having overwhelmed Pittsburg makers. We quote 1.25c Pittsburg, with prices from local mills on the same basis. Sheets are about $2 a ton higher than 10 days ago, and in small lots No. 28 are quoted 2c Pittsburg by local sellers. Bars are unchanged. Car orders keep up the tonnage. We quote .95c valley for iron and .95c Pittsburg for steel.

OLD MATERIAL.—There is a trifle more firmness in some departments, while others have not changed in consequence of better prices in iron. Mills are rather larger buyers. A lot of 100 tons of old iron rails sold by the Nickel Plate was bid on recently by more than a dozen dealers. We quote $14 to $14.25, valley mill. On old steel rails $9.50 is the usual figure. We quote machinery cast scrap $8.25 to $8.75; No. 1 railroad wrought, $12; stove plate, $6; busheling scrap, $8.50.

CINCINNATI.

Dec. 27.

The general activity of the market continues unabated, and there is every indication that the closing week of the year will be as active as any week of the eventful year 1898. Sales continue in such volume as to take up the full output of the furnaces, and the warrant yards continue gradually to give up some of their holdings. There are evidences that stocks will be reduced fully as much in December as they were in November. The demand comes for foundry and mill grades, Northern and Southern, so that all the furnaces are being entirely satisfied as to the volume of business offering. There is reason to believe that before the close of the year prices in all districts will be advanced slightly. Fortunately there continues an anxiety on the part of all interested in the trade to avoid any wild and excited condition of the market. Trade is still hampered with difficulties of transportation, and furnaces and coke ovens are handicapped by insufficient rolling stock, though the railroads are apparently doing their best. There is an entire absence of any speculative buying and all the transactions are upon a strictly business basis, consumers simply looking for material to provide for their production of finished product. The market is firm. We quote for cash f. o. b. cars Cincinnati: Southern Coke, No. 1 foundry, $10.25 to $10.50; No. 2, $10 to 10.25; No. 3, $9.50 to $9.75; No. 4 and gray forge, $9 to $9.25; mottled, $9 to $9.25; No. 1 soft, $10.25 to $10.50; No. 2, soft, $10.00 to $10.25; Hanging Rock charcoal, No. 1, $14.75 to $16; Jackson Co. silvery; No. 1, $12.50 to $12.75; standard Georgia car wheel, $14.25 to $15.

PHILADELPHIA.

Dec. 27.

So far as actual business is concerned the past week is probably not so conspicuous as the preceding one. Such heavy buying as went on in the first three weeks of December is too much to expect at the close of the year. It has been by far the heaviest December on record, and buyers and sellers are glad of a breathing spell just before the year goes out. With stocks lighter, in comparison with production than ever known at the end of the year, and a further reduction certain to be shown in the statement for Jan. 1, there is a strong basis for an advance. Sellers have been quite conservative thus far, Lehigh Valley No. 2 foundry having sold in the past week at $11 tidewater, or about $10.50 at furnace. Southern sellers in this market, representing Alabama and Virginia furnaces, have booked all they can take care of and some of them are out of the market. Many furnaces are heavily sold for the first half of the new year and it is not improbable that an advance of 25 cents on all deliveries will be made within the week. It will take a little time to determine to what extent, if any, furnaces are oversold for the first two or three months of 1899. We quote on No. 1 X foundry, $12.25 to $12.50; No. 2 X, $11.50 to $11.75. The billet market has got away from buyers. Those who a fortnight ago were naming $17 as an acceptable figure now find that $18 is not considered by steel works. Some sales at $18.25 are reported, but no great tonnage is wanted at that. The week has demonstrated how abundant is the tonnage in rolling mills, nearly all descriptions of finished material being sold well ahead. The export trade goes on so steadily that tonnages that but a short time ago would have been a matter of comment, are closed now, week by week, and treated as a matter of course. The Russian rail contract, amounting to 80,000 tons, taken by Pennsylvania Steel Co. and Maryland Steel Co. is followed by the announcement of 35,000 tons of rails for Australia, to be rolled at the Sparrow's Point plant. The plate mills have simply been sold to a standstill. Eastern mills are taking nothing but the trade of their regular customers, and the shortage of Pittsburg mills is overflowing into this territory, but without being taken care of. The advance is about $1 a ton in the week, tank being now quoted at 1.35c to 1.40c. Beams and channels are in good demand and considerable work is being figured on. The possibility of an advance of $1 to $2 a ton by the associated structural mills is being discussed. Bars are still a very conservative factor and no advance is reported.

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AND
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DECEMBER 29, 1898.

TIN PLATE POSSIBILITIES.

What the price of tin plate is to be under the consolidation is still a matter of conjecture to the trade. The lowest authenticated prices under the competitive regime were $2.50 at Indiana mill and $2.55, Pittsburg district, for 100-pound coke plates. The figures named as likely to be fixed by the American Tin Plate Co. range from $2.80 to $2.90. Not a marked advance over the extreme of profitless prices made by mills, some of which found their only salvation in keeping in operation, even to get back a new dollar for an old one. It is evident from the composition of its directory and the safeguards thrown about the rights of its stockholders, that the new company is to be managed with an eye to the future and not for the temporary gains of the stock market. There are possibilities of competition from interests that have their own ore, blast furnaces and steel works, that will probably not be overlooked by the astute members of the new directory. Any large advance would certainly stimulate the building of tin plate works; and it need not be said that thoroughly modern mills can be erected at a figure quite below the basis of the consolidated company's valuations. What will develop in this direction will depend, perhaps, as much upon the buying as upon the selling policy of the new company. Steel works that have found an outlet for a portion of their product in the tin plate trade may still prefer to do so, whether or no they are included among the firms from which the consolidated company buys tin bars. The advantage of a company that has raw materials at cost, from ore down to tin bars, is self-evident. All through the iron trade the tendency among producers of finished material is to form connections that will guarantee a supply of raw materials, running back to the mine, on a basis free from fluctuation, so that costs will be known, within certain limits, over a term of years. The tin plate consolidation, so far as its plans are in evidence, starts with an intermediate product whose fluctuations in the open market have been considerable, even in the year of steady prices just closing.

A factor of cost in the case of the American Tin Plate Co., that will offset some of its economies of reduced official lists, simplified selling organization, and shipments from the mill nearest the consumer, is the interest on unused plant. How much of its capacity will be kept out of operation is yet to be determined, but it is known that some of the plants were purchased under the stipulation that they be removed from their sites, the title to the real estate remaining with the original owners. The plan evidently is to concentrate production in the largest and best located plants; but the non-producing mills will be a charge, large or small, that must be reckoned with, in computing fixed charges.

Another matter, the outcome of which will be watched with no little interest, is the attitude of the new company toward the Amalgamated Association. The friction that will arise, if any, will not be so much over the rate of wages as over the limitation of output which the workmen have succeeded in maintaining, with some little concessions from the regulations imposed by the Welsh tin plate workers' union. Tonnage is an imperative demand of big producers; and it will be no surprise to see this issue joined when the next scale comes up for discussion.

No aggregation of capital and of manufacturing talent has been formed, with more promise of wise administration, judging from its charter provisions, with their judicious guarantees of individual rights; and yet none has started out with more chances of self-injury through mistaken policies. If the same talent is displayed in administration that has been shown for bringing together conflicting interests and for financing successfully so large an undertaking, the future can scarcely be in doubt.

THE actual returns of new railroad building in the past year bear out all that has been said in general terms as to the unique record for railroad prosperity that has been made by 1898, out of all the years since 1892. The *Railroad Gazette* puts the total mileage of new road at 2,867, with the reservation that later reports will somewhat enlarge this total. Last year showed 2,188 miles; 1896, 2,112 miles, and 1895 shows the lowest mileage since the panic —only 1,603 miles. Minnesota leads in the building of new track for this year, with 253 miles.

Then follow Texas, with 188 miles; Louisiana, 171; Alabama, 161; Oklahoma, 157; Arkansas, 140; Maine, 123; California, 115; Missouri, 111; Michigan and Georgia, each 104. It is an interesting fact that four of the States have more than one-fourth of the new mileage, while it required 33 States and Territories to make up another fourth of the increase. One-half of the 2,867 miles was in nine States and Territories. A characteristic of the railroad building of 1898 is that it has not been confined to any one section of the country. On the whole the South and West have built the largest mileage, and yet the old State of Maine has added 123 miles to its railroads, and New York State 64 miles. The Mississippi Valley, although apparently well supplied with roads, has received large increments in nearly every section. Marked as has been the improvement in new mileage during the past year, if present indications count for anything the aggregates for he coming year may be expected to be even larger. For, with the roads already under construction, and with the new projects arising so rapidly that it is almost impossible to chronicle them, the year 1899 opens more promising in the field of new railroad building than any year of recent times.

Canada and Mexico likewise have had a year of prosperity, as indicated in railroad extensions. In Canada 10 roads have built 448 miles, or 53 miles more than reported last year, the Canadian Pacific contributing 262. Ten roads in Mexico built 412 miles, or 100 miles more than reported last year.

AMERICAN STEEL AND WIRE CO. DEALS.

The fact that the American Steel & Wire Co. has been negotiating for the purchase of additional wire rod, wire and wire nail plants has been known in a general way to the iron trade for several weeks. In the past week one of these pending transactions is reported to have been closed up, the consolidated company acquiring the plant, equipment and manufactured stock of the Cincinnati Barbed Wire Fence Co., whose mills at Fairmount, near Cincinnati, have a capacity of 55,000 to 60,000 tons of wire a year. It is understood that the deal does not include the book accounts or any other assets of the company except as stated above. While the Cincinnati concern was not one of the largest competitors of the American Steel & Wire Co., its acquisition was desirable because of its command of an important Southern trade. Its products are wire nails and barbed, plain and galvanized fence wire.

Other additions to the big company are in contemplation, also. Options have been taken on majority of the stock of three companies—the Cleveland Rolling Mill Co., Cleveland; the Oliver-Snyder Steel Co., Pittsburg, with its allied interest, the Oliver Wire Co., and the Pittsburg Wire Co. In the case of the Cleveland Rolling Mill Co. the option runs until Jan. 18, when a meeting of stockholders will take action on the proposition to sell. The contract already made provides that the buyers shall also take so much of the balance of the Cleveland Rolling Mill Co. stock as shall be offered to them at the same price. It is believed the transfer will be made, though it is probably contingent upon the success of the American Steel & Wire Co.'s efforts to get hold of other properties, since the aim is to have a more complete control of production than has been possible with 14 plants within the consolidation and 10 outside. The basis of the sale of the Cleveland Rolling Mill Co. is not stated; but in the original and more inclusive consolidation plans of the early part of this year the Cleveland company's stock was put in at $5,000,000—4,000 shares at $1,250 a share. The company's properties include three blast furnaces, with capacity of 700 to 800 tons a day; two 10-ton converters with an annual capacity of 350,000 to 400,000 tons of ingots; open-hearth steel works producing 20,000 tons a year; blooming mill, structural and bar mills; two rod mills with annual capacity of 100,000 tons; wire mills producing 90,000 tons a year; 30 nail machines, annual capacity 200,000 kegs. The company also controls the Jackson and Negaunee mines on the Marquette range and is interested in ore-carrying vessels.

The aim of the American Steel & Wire Co. is evidenly to secure control of sources of raw material supply, reaching back not only to billets but to pig iron and in part to ore. The Cleveland steel plant run to its fullest capacity would almost supply sufficient steel for the company's Cleveland plants, or at least for so much of the consolidated company's total output of wire and nails as can be most economically marketed from Cleveland.

In the Pittsburg district the aim is likewise to get control of pig iron and billet capacity. There is a possibility that the Pittsburg Wire Co.'s plant would not be operated to any extent after its acquisition. It is evident that all the mills in the present supplemental program of consloidation will not be needed. In the plant of the Oliver & Snyder Steel Co., a billet capacity of 125,000 to 150,000 tons a year would be secured, together with Edith and Rosena blast furnaces, the two capable of producing over 200,000 tons of pig iron a year.

By controlling so large a portion of its billet supply as the two steel works for which it is negotiating would give it, the American Steel & Wire Co. would be independent of the Federal Steel Co. from which its mills have long been large buyers. The pending deals thus do not add to the chances of an amalgamation of the two big interests, of which so much has been written.

Mention was made in these columns a few weeks ago of the offer of 165 for Washburn & Moen Mfg. Co. stock by a firm of Boston lawyers whose principals were not disclosed. It is reported that no large amount of the stock has been deposited on this offer; on the other hand is the report that a large block of it has been secured in the interest of the American Steel & Wire Co. The plan now being worked out is evidently to accomplish the larger amalgamation of wire interests at which the promoters of the original scheme aimed—that is, to do piecemeal what could not be worked out in a single deal.

The stock market reflects the effect of the consolidation movement. American Steel & Wire common, which started at about 30 last summer, rose to 50 on Tuesday of this week, after having been for some time about 40. The preferred, which was at 87 a few months ago touched 108⅛ on Tuesday. In the case of the Cleveland Rolling Mill Co., at least, and presumably in the case of the Pittsburg plants, the purchase is to be for cash. To do this the capitalization, which is now $24,00,000, half preferred and half common, will be increased.

Pittsburg Foundrymen's Association.

The December meeting of the Pittsburg Foundrymen's Association was held Tuesday evening, Dec. 27, with about 25 members in attendance. The paper of the evennig was by Dr. Wm. B. Phillips on "Yard Grading of Pig Iron" and is given in full elsewhere. There was a discussion, participated in by Dr. Moldenke, Dr. Phillips and Messrs. E. A. Kebler, I. W. Frank and J. S. Seaman. The opinion expressed by several members that action should be taken looking to greater uniformity in methods and standards of grading pig iron finally took form in a motion. It was generally agreed that chemistry should have a larger place in furnace grading and should be the basis on which iron is bought.

The resolution finally passed was in this form: "Resolved, that the Pittsburg Foundrymen's Association recommends to the American Foundrymen's Association the adoption of standard methods of grading pig iron for foundry purposes, and that our representative be requested to bring this matter before the executive board for action." The Pittsburg district's member of the executive committee is I. W. Frank.

THE Carnegie Steel Co., Ltd., will erect a 100-inch plate mill on the land purchased recently for the Hays estate. This mill will be used in connection with the steel freight car works, on which operations will begin in about a month, as the plans are now well under way. The smaller sizes of plates will of course be rolled on one or more of the smaller plate mills. The steel car works will have a capacity of 40 cars a day, which means about 500 tons of plates a day, there being considerable waste.

THE plant of the United States Iron & Tin Plate Mfg. Co., Demmler, Pa., has heretofore been operated part on sheet iron and the balance on tin plate. Some of the mills are equipped as sheet mills, while others could be used for either sheet iron or tin plate. The whole plant has just been rebuilt, and it is learned that it has been turned over entire to the American Tin Plate Co., there being 11 complete and up-to-date hot mills for rolling tin plate.

THE tin mills of the Ætna-Standard Iron & Steel Co., located at Bridgeport, O., have recently been removed from their several locations and arranged in a single group, so that in the sale of them to the tin plate consolidation no inconvenience was experienced. The tin mills are located on one side of the railroad and the balance of the plant on the other, the railroad forming the dividing line between the property of the Amrican Tin Plate Co. and that of the Ætna-Standard Iron & Steel Co.

THE Syracuse Tube Co. is making plans for an extension of its works at Syracuse, N. Y. Two additional lap-weld furnaces will be built and a quantity of new and improved machinery is already under way. It is hoped that the new plant will be ready to start not later than April 1.

THE American Pig Iron Storage Warrant Co.'s report showed 155,300 tons in yard Dec. 20, 4,100 tons having been withdrawn and 300 tons put in yard in the preceding 10 days.

AMONG the 1899 calendars that of James V. Rose, proprietor of the Sharon (Pa.) Fire Brick Works, is conspicuous. The head-piece is a reproduction of Leon Moran's painting, "Tory or Continental?"

THE YARD GRADING OF PIG IRON.*

BY WM. B. PHILLIPS.

In a curious report made to the King of England, about 260 years ago, on the subject of the manufacture of pig iron, it was stated that there were then made three kinds of iron, to wit, in the original words: "The first sort is gray iron. The second sort is called motley iron, of which one part of the sows or pigs is gray, the other part is white intermixed. The third sort is called white iron; this is almost as white as bell metal, but in the furnace is least fined, and the most terrestrial." The author goes on to say: "I may take occasion here to speak of the nature of cold-share iron, which is so brittle if made of the grain ore, or iron stone would be almost as brittle as some regulus antimonii, made with iron, for with one small blow over an anvil you may break the biggest bar of it, if it be a perfect cold-share iron—nay, the ploughman often breaks his share-point off, if it be made of cold-share iron; but perfect tough malleable iron will not break feasibly in hot or cold, as cold share iron will, or red hot as sulphurous red-share iron will, but yet tough enough when cold; all of which aforesaid qualities of iron the author well knoweth how to mend their natures, by fining or setting the finery less transhaw more burrow, which are terms of art, and by altering and pitching the works and plates, the fore-spirit plate, the truiron bottom, back and breast or fore plate, by the altering of which much may be done, if the work be set transhaw and transiring from the blast; the iron is more cold-share, less fined, more to the master's profit, less profitable to him that makes it into manufactorage, and less profitable to him that useth it, but the iron made in a burrow work becometh more tough and serviceable. Yet the nature of all iron-stone is to be considered both in the furnace and in the finery; the sulphureous, arsenical and veneriating qualities, which are oftentimes in iron-stone, to be made to separate in both the works from the fixed and fixing bodies of iron, whose fiery quality is such that he will sooner self-calcine than separate from any sulphureous veneriated quality."

This, gentlemen, is one of the earliest attempts to grade pig iron on the yard. It was in the time of Charles I. and Oliver Cromwell and passed as the most scientific description that had yet appeared. Since that day we have drawn away from the arsenical, veneriating quality of pig iron and have substituted cold-short for cold-share iron, but in other respects the description might be used to-day. If we "set the work transhaw and transiring from the blast" we get certain kinds of iron which the yard-grader knows, by the grace of God, but which may or may not be what is needed at the foundry. If the spirit of Dud Dudley could make the rounds with a pig iron breaker and grader he would feel perfectly at home and would rejoice that the art which he founded in England 260 years ago had not progressed much beyond its original lines. Dudley had three grades of iron—gray, mottled and white. We have 13 grades regularly and as many more as may be necessary to confuse the purchaser.

On the yard and without any help, other than is given by his own experience, the grader distinguishes between the following kinds of iron, to wit: Open silver gray, close silver gray, No. 1 soft, No. 2 soft, No. 1 foundry, No. 2 foundry, No. 3 foundry, No. 4 foundry, gray forge, mottled, white. If he needs other grades he makes them as he goes along, so that instead of being annoyed at the absurdity of the performance, we ought to be thankful that he stops with 13. The first eight are grouped under the term "foundry irons," while gray forge, mottled and white are known as "mill irons."

Various Grades Defined.

The grader will tell you that the silvery irons are silvery irons; that they have a fine, silvery luster on the fresh face and are flaky, that they have little or no granulation and are weak in fracture, and that they carry from five to six per cent of silicon. He will tell you that they are the "hottest" irons, "the work being set transhaw and transiring from the blast," and that they contain very little combined carbon, about the only thing at present which is not controlled by a trust, although it certainly is in a combination. He will then go on to tell you that the soft irons begin to show granulation, that the color is light, the face smooth and the fracture weak, and that the silicon is from three to four per cent. They are not as flaky as the silvery irons, nor so jagged as the foundry irons, and the darker color is due to graphitic carbon.

In No. 1 foundry the color is dark, the granulation very open and regular, the crystallization is well marked and the face is rough to the feel. The silicon is from 2.50 to 3.0 per cent, while the proportion of graphitic carbon is considerably larger than in the soft irons. No. 2 foundry differs from No. 1 in having a closer grain and a finer crystallization, the color may be as dark as in No. 1, but there is lacking a blackish-gray, velvety color which is always present in the other grade. The silicon may be from 2.25 to 2.50 per cent. And so on with No. 3 and No. 4 foundry, these containing, respectively, 2.0 to 2.25 and 1.75 to 2.0 per cent of silicon. Gray forge contains from 1.50 to 1.75 per cent of silicon and has a pebbled granulation in the center, with mottled edges. The face is blistered and pitted and is often honey-combed. Mottled iron has from 1.25 to 1.50 per cent of silicon, no granulation, and shows a pepper-and-salt appearance on the fresh face. White iron has no granulation at all and is often as white as bleached linen, but is not silvery.

After some years of intimate connection with this system of grading, I have reached the conclusion that, as a rule, the graders are very conscientious in applying the knowledge gained on the yard and that no better results can be expected under any exclusively yard system than are found at present. The objection to the system is that it is radically wrong in principle, not in administration. Given the principles now governing it and it will be found that they are faithfully carried out. The question is not whether better results can be had under the present system, but whether the present system is not wrong. It is granted that the present grading is carried out as well as it can be, but this is no more than saying that the wooden plough with a yearling at the one end and a stripling at the other does as well as can be expected. The wooden plough may only scratch the surface, but this is all that it is expected to do, and those who would sub-soil with it are destined to many disappointments. So it is with the system of yard-grading now in use; it does as well as can be expected of it.

The tendency of the trade is now strongly towards a closer chemical inspection of the irons offered for sale; and the grader who intends to keep up with his profession must take this fact into consideration. He must acquaint himself with the effect of the chief constituents upon the various irons in respect of color, granulation, fracture and face. He is called upon to decide questions involving a great deal of money, and as it may happen that he cannot wait for an analysis he must be prepared to grade without it. He should, by all means, cultivate the closest intimacy with the laboratory, have the various grades analyzed as often as possible, and not neglect to inform himself as to the influence of the burden, heat and pressure upon the product under his care. But when this is done and after he has repeatedly standardized his eyes it is impossible for him to grade accurately unless the furnace is running uniformly. It is in this respect that furnaces so situated as to be able to buy large stocks ahead and run for months on almost the same ore, fuel and stone possess many advantages over those that live, so to speak, from hand to mouth, and take what they can get.

Lower Silicon the Rule.

Let us take a district in which is produced about one-third of the foundry, pipe and mill irons made in the United States. I do not speak of the steel trade at all, for the system of grading irons for steel making is altogether different. Any one at all familiar with the district referred to knows that it has become difficult to make soft irons there. The old analyses of 4.50, 5.0 and 5.50 silicon are rare, the silvery irons are conspicuous by their absence, while No. 2 soft has dropped back into the position formerly occupied by No. 1 soft; and No. 1 soft is often found with the silicon of No. 3 foundry. The irons that formerly carried from three to five per cent of silicon now carry from two to three per cent, and this too without having suffered any notable change in appearance. Perhaps it would be fairer to say that the changes in appearance by which the grader is guided are not of such a nature as to enable him to seize upon and use for his purposes. Be the explanation what it may, the conscientious grader is brought to face this practical difficulty—the former high silicon irons

* Read before the Pittsburg Foundrymen's Association, Dec. 27, 1898.

have changed their composition without having changed their appearance correspondingly. An iron that looks like a No. 2 soft, or a No. 1 soft, and which, according to ordinary yard grading, would be classed as such, is found to contain less than 2.50 per cent of silicon, and may contain only 2.0 per cent. The writer has known instances where a certain iron, graded by two competent men as soft really had less than two per cent of silicon, and could not have been sold as soft iron.

In a certain district in this country, it was stated by the manager of the furnaces 10 years ago that No. 1 foundry carried 3.66 per cent of silicon, No. 1 mill, which was also known as No. 3 foundry, carried 2.87, and No. 2 C (a silvery iron), as much as 7.09. In this same district there has been a complete change in the composition of the irons and yet the same absurd system of nomenclature is employed without regard to the fact that it no longer applies. Ordinarily and when grading from the same furnace running on about the same burden, etc., the competent grader comes very near the proper grade, and may be trusted to ship on his own judgment. But when complaints arise, and we are all familiar with this phase of the perversity of human nature, the consumer must be shown that the iron that he objected to as not being No. 3 foundry, for instance, does really contain from 1.75 to 2 per cent of silicon, irrespective of its appearance. This much as to silicon. But how is it when it comes to graphitic and combined carbon? Is the iron to be graded solely by its silicon content? It is granted that, for the most part, iron can be fairly well graded on its content of silicon, and that this element confers upon the iron peculiarities of color, granulation, fracture and face that are more strongly marked than peculiarities due to other ingredients. It is this fact that has rendered possible the present system of visual and tactual grading. It was quietly assumed that if the silicon was all right the iron was all right, and, as it is a poor rule that will not work both ways, if the iron was all right the silicon was all right.

Silicon the Basis.

The easiest way of grading iron is by its silicon content but it by no means follows that it is the best way. Disregarding the content of sulphur, as not seriously affecting any of the grades above gray forge, it seems to me that there should be certain ratios established between silicon and combined carbon, or between silicon and graphitic carbon, for the soft and foundry irons. The variation in the amount of silicon does, of course, influence the quality of the iron, and one might go even further and say it influences the iron more than any other single ingredient. But combined carbon is by no means to be neglected. In 29 complete analyses of iron graded as No. 3 foundry, the writer found that the silicon varied from 1.45 to 3.83, the average being 2.37. Five of the samples should have been graded as No. 1 soft, as the silicon was between 3.04 and 3.17, and one should have been No. 2 soft, with silicon 3.83. These irons were all graded on the yard by a careful and competent man, yet in six cases out of 29, or 20.7 per cent, the iron graded as No. 3 foundry was really soft iron. Excluding these six, the average silicon in the other 23 was 2.16 per cent, a result not far wrong, as No. 3 foundry may contain from 1.90 to 2.20 per cent of silicon. Now, in the six cases that gave silicon much above the normal amount for No. 3 foundry iron, the combined carbon was over one per cent, while in the irons that could have been shipped as No. 3 foundry, the combined carbon was about 0.85. The combined carbon in No. 3 foundry does not usually run as high as 0.85, the average being about 0.40, and in the soft irons it should not exceed 0.40 per cent. But when the soft iron resemble in appearance the foundry irons it will generally be found that the combined carbon is high. We have then to discriminate between soft irons with over three per cent of silicon and the normal amount of combined carbon, and irons which contain over three per cent of silicon and over one per cent of combined carbon. Grading on fracture and appearance, some of these latter irons would be put in No 3 foundry; grading on silicon content they would go into sott iron, with the understanding that the combined carbon was abnormally high.

The same principle holds good with respect to the other foundry irons, although in a less degree. It is the tendency of the lower grades of foundry irons to show a higher percentage of combined carbon than is usually the case that renders grading by fracture, etc., uncertain. In case of doubt, a silicon estimation will enable one to decide whether or no the iron should be put in the soft grades, and an estimation of combined carbon would decide whether or no it should be stated that this element is above the average.

The purpose to which pig iron is put depends absolutely upon its composition; the color, fracture, granulation, and face have nothing to do with it except in so far as they indicate the existence of certain ingredients in certain quantities, whose actual amounts can be determined only by the chemist. As regards grading on the yard, the inferences to be drawn are reliable only if confirmed in the laboratory, and the sole question is whether or no chemical composition so affects the physical appearance of pig iron as to enable us to grade it without recourse to the chemist. Now, it is conceded that with uniform stock and uniform practice at the furnace a good grader will come very near to the chemical composition. We may allow that he comes sufficiently near for the difference not to be appreciable when the iron is used in the mill, the foundry and the pipe works. But fully one-third of the iron for such purposes is made under conditions that do not allow of uniform stock, and without uniform stock there can not be uniform practice, and we are compelled to fall back upon the laboratory.

Furthermore, I am convinced that if foundries would pay more attention to the composition of the irons they buy there would be less complaint in the trade generally. We are coming to understand that there may be and often is a wide variation in the composition of foundry irons, and that when a shipment is purchased as foundry iron there may be all sorts of things in it. Many curious discrepancies in the results from using so-called foundry irons are due to the fact that there was nothing known about the iron in the first place except that it was foundry iron, and the term is a very illusive one.

Proposed Improvements in Grading.

What changes are to be suggested by which not only the sale but also the use of pig iron could be largely helped? The present system is open to such an array of objections that it does not seem to be necessary to discuss it further. But if it is to be changed what form should it assume? Almost any one can tear down a structure, but unless he has something to suggest in place of it he can not be said to have done much good.

I would suggest that instead of the present 13 grades, there be used only six and that in grading iron the three elements of silicon, combined carbon and sulphur be used, with the understanding that for certain purposes the phosphorus also be included. These six grades might be as follows:

	Silicon.	Combined Carbon.	Sulphur.
Silvery irons	5 to 6	0.10 to 0.30	0.01 to 0.04
Soft irons	3 to 5	0.30 to 0.60	0.01 to 0.05
Foundry irons	2 to 3	0.30 to 0.90	0.01 to 0.07
Gray forge	1 to 2	0.40 to 1.25	0.04 to 0.09
Mottled	0.6 to 1	0.50 to 1.80	0.06 to 0.11
White	0.1 to 0.6	1 to 2.50	0.08 to 0.30

This scheme, or some modification of it in line with its general provisions, would retain the present nomenclature, and bring it into closer accord with laboratory results. It would do away with five grades, which are no more than side-grades at best, and would enable the grader to exercise better judgment on the yard. The rapidity and accuracy with which silicon estimations are now made leaves very little to be desired, and the same may be said of sulphur and combined carbon, for such purposes as are here indicated. The main thing is to make a start in this direction, and the details of the analytical methods to be adopted can be settled afterwards. It is not required that for such material the methods should have the same degree of refinement as is required in the steel trade where the effect of very small variations in the amounts of certain ingredients is stongly marked. We are dealing with a rougher class of material in which there can be allowed a longer swing of the pendulum. In the steel trade it is now recognized that methods of analysis must be based as far as possible upon the nature of ete metal under examination. A method which gives good results on crucible steel does not necessarily apply to Bessemer or to open-hearth steel. It would not be a matter of great difficulty to devise methods for the examination of pig iron intended for foundries, or mills or pipe works. If foundrymen generally should make up their minds to purchase pig iron on analysis it would not be long before the producers of this kind of material would

have to fall into the plan with a method of examination that would be acceptable.

It is a noteworthy circumstance in connection with this matter that the very kind of iron on which some of our Southern friends are basing the highest hopes, basic iron for the manufacture of steel, has been sold from the very beginning on analysis, the specifications being so drawn that a rigid inspection of it was demanded. It has come into use on a large scale, and justly so for, it is an excellent material for its purpose, and the present steel works building near Birmingham, Ala., could never have been undertaken had it not been shown that this kind of iron could be made there. Finding that the trade in foundry, mill and pipe iron was not altogether as much as they wanted, they propose to make steel and to make it from the very iron that has always been sold on analysis. In common with most makers of foundry irons, they have declined to sell foundry iron on analysis, but when they found that they could sell basic iron only on analysis they gladly entered into the business. In other words, the steel men in the country are ahead of the foundrymen in that they can and do get iron on specifications as to composition, and the only reason why the foundrymen have not been able to do this is because they have not demanded it.

Improvement Begins at the Foundry.

It seems to me that in some respects we have gone at the improvement of foundry practice from the wrong end. We are trying to study the iron after it leaves the foundry, while it is quite as important to study it before it reaches the foundry. A great mass of information has been acquired as to this point and that point in castings, but the foundation of the whole thing is left to take care is itself, and foundry iron is foundry iron, no matter whether the silicon is 3.50 or 1 50 per cent. If some of the attention now being given to castings were given to pig iron before it gets into the castings, I believe we would make great strides towards a better understanding of the art of founding.

Some years ago in connection with the inspection of the regular make of foundry iron at an establishment where I was empoyed as consulting chemist the following plan for keeping track of samples was devised. It was used for a long time with the happiest results, but finally fell into disuse because it was impossible to interest the management in the importance of the subject. But while it was used we certainly got to know a great deal more about the iron than was ever known before. We had stout manila envelopes prepared, 3x6 inches in size. On front was printed the following:

.....Company.
.....tons of..... .....Grade.
Made ....in No..... .....Furnace.
Sampled..... .....by.....

(Mark out the word that does not apply).

Color { Light. / Dark. } Fracture { Weak. / Strong. } Face { Smooth. / Pitted. / Blistered. }
Chilled edge.....
Granulation { Regular { Fine. / Medium. } / Irregular { Medium. / Coarse. } }

On the back of the envelope was printed a form for recording the burden, heat, pressure of blast and revolutions of the engines corresponding to the pig iron that was sampled. The samples were sent in to the laboratory and analyzed, and a report made to the management, to the furnace superintendent and to the grader on blanks corresponding to the envelopes. In this way a great deal of valuable information was secured at a minimum expenditure of time and labor. The composition of the irons was observed according to the furnace practice, and the original yard-grading was checked by actual results in the laboratory under a system that allowed of very close inspection of the iron.

The envelopes were prepared after many consultations with the chief grader and others interested in the accurate grading of iron for commercial purposes. We recognized the fact that in yard-grading it was necessary to take careful note of color, fracture, granulation and face, whether the color was light or dark, the fracture weak or strong, the granulation regular or irrgeular, and whether fine, medium or coarse under each of these divisions, whether the face was smooth, pitted or blistered, and finally whether there was a chilled edge on the iron or not. After receiving the analysis the grader was in position to know a great deal more about the iron than he could have known before, for he standardized his eyes by actual laboratory returns and in a methodical and scientific manner.

A closer inspection of foundry irons is second in importance to no other consideration that can affect the business. The work on standard test bars is of no greater importance than this and it is earnestly suggested that some steps be taken by this association, and later by the National Association, towards the purchase of foundry iron on analysis.

American Tin Plate Co. Plans.

The officers and executive committee of the American Tin Plate Co. met in Chicago last week, and are meeting again this week. It was expected that some definite conclusion would have been arrived at by this time as to the selling policy of the company, but no information has been given out. There is much curiosity in the trade to know if any arrangement has been made in regard to bars. It has been mentioned in these columns that a story was out that arrangements had been made with two bar mills to secure bars at an unusually low price—a price lower than the ordinary buyer would be likely to secure. The latest story is that there has been an apportionment of tonnage among all the bar mills, in consideration of which the mills are not to sell tin bars to others except at a higher figure. It does not seem to be understood that since the explosion of the theory that boshing improves a tin bar there has been absolutely no difference between sheet and tin bars except in the lengths to which they are sheared. This is of no consequence, as the custom has been growing among the tin mills of ordering long lengths and shearing to suit the orders, which can be done in the tin mill at a cost no greater than is charged for shearing by the bar mill. On this account it would be possible for the sheet mills to buy bars and turn them over to outside tin mills, without any great expense being involved in the tarnsaction.

Ore Handling Plant for Ohio Steel Co.'s Furnaces.

The Ohio Steel Co., Youngstown, O., has made a contract with the Webster, Camp & Lane Machine Co., of Akron, O., for the ore handling plant for its two furnaces now under construction. The contract embraces one Hulett patent car dumper of a capacity to handle the largest steel hopper ore cars. It receives the cars as they come from the lake ports, dumping each car into a series of four buckets set side by side, on a special car standing on a lower track. These special cars will be shifted by switching engines to any point along the side of the stock pile at which it is desired to stock the ore. The stock pile ground is commanded by two bridge tramways of 250-foot span, with a cantilever at the back end overhanging the tracks leading to the furnace. These tramways have a capacity to handle a 17-ton bucket or wagon, and have electrically driven machinery in the main tower, by means of which the small ore cars are drawn up an incline and across the bridge to any desired point, an automatic device dumping the car where it is desired to stock the ore. These bridge tramways have a movement up and down the yard, so as to cover its entire length, and in addition to the special cars or wagons for unloading the ore, the same bridges and machinery handle a scoop bucket which is used for taking ore from the stock pile and discharging it either into the ore bins or into drop-bottom cars, as desired.

The advantage in the system as planned is that, in addition to the great capacity of the bridges for handling ore, it is adaptable to any class of cars, does away with expensive trestles and requires but a small amount of labor in handling the ore. The plant is to be in operation by June or July, 1899.

THE Keystone Bridge Works of the Carnegie Steel Co., Ltd., located in Pittsburg, have been cramped for room for some time. Recently additional ground was purchased adjoining the works, and it is now understood that some extensive improvements will be made at the works, the enlargements covering the ground purchased, much of which will be used as erecting yards.

GOOD RECORDS FOR GRAPHITE PAINT.

Considerable has been written lately about an old sign in possession of the Western Society of Engineers at Chicago. The words "Harper's Ferry," painted in black, stand out as boldly as when they were first formed by the artist's brush, while the wood around the letters, which was painted with white paint, has worn away about one-sixteenth of an inch. It is asserted by the writers that no paint manufactured nowadays is equal in durability to that which was applied on the old sign.

Wm. Hooper, of Ticonderoga, N. Y., does not see anything specially remarkable in the preservation of the old sign and claims that there is just as good a paint made nowadays as then. He adds: "I have seen signs that have been painted with black paint directly on the clapboard of the building. The lettering was good after the paint on the balance of the building had disappeared, and after this the whole building was painted over, lettering and all, and the lettering obliterated; yet within 10 years afterwards the old black lettering appeared again quite freshly to view. I suppose the paint for the lettering was made of linseed oil and lamp black. I believe, however, that finely ground graphite mixed with pure linseed oil, will last as l ng, or longer, than any other paint ever known of or used. I had a large iron casting which lay in my mill yard for over 30 years. It was painted with only one coat. The old casting was broken up and sold for old iron last month and I noticed that the paint on the pieces of casting, even after being broken up, looked quite fresh.

"If the surface to be painted is perfectly dry when the finely ground graphite is applied, the paint will prove the most lasting paint known, because if time eliminates all of the oil, the graphite seems to adhere to the surface painted just the same as a piece of paper or wood will appear after it has been rubbed with a lead pencil or a piece of graphite. No other pigment known to me will remain on the surface painted after the oil has been thoroughly destroyed. With the experience I have had with graphite paint, I thoroughly believe that if any dry surface be covered with graphite paint and left untouched for a period of 30 years,—by which time the oil will have disappeared—no doubt a letter could be written plainly on the surface by using a piece of large wire or nail after smoothing the end of the wire or nail which is to be used as a pencil. I have done all this and shown it up to others. Writing with the piece of wire, polishes the graphite, which adheres to the surface, showing that it is there still."

American Locomotives for England.

In spite of an extraordinary domestic demand for railway equipment and supplies, American manufacturers are pushing their way steadily into foreign fields. The announcement made elsewhere in this issue of the order which the Midland Railway of England has placed with the Baldwin and the Schenectady Locomotive Works, for 20 locomotives will be a surprise to many of our readers. It is easy to understand how American builders may enter into certain markets and supply motive power for railways in China, Japan, Russia and the South American countries, but we scarcely expected to ship locomotives to England so soon.' The surprise will not be confined to this side of the Atlantic, either. It will be interesting to observe the antics of the editors of certain engineering and financial journals on the other side. Those who have so consistently and patriotically maintained that American machinery, however well designed, was poorly made and not to be classed with that of British manufacture, will have a splendid chance to criticise, and, if possible, prove their case by actual demonstration on the spot. The circumstances under which these locomotives were ordered are exceptional, to be sure. The American builders could and the English builders could not make satisfactory deliveries. The delay incident to the recent engineers' stike has put the English manufacturers so far behind in the matter of filling orders that much business has been lost to them for the present. Nevertheless, the fact that 20 locomotives of American make will soon be running on an English road is of the greatest importance, and it will not be in the least surprising if these are not the last.—[Railway Age.

THE Kingman Plow Co. plant at Monmouth, Ill., formerly Weir Plow Co., is to be removed to Averyville, Ill.

A SAMPLE MISTAKE ABOUT OUR EXPORTS.

The amount of hasty generalising done by the English press in its comments on American industrial conditions, particularly as they affect exports from the United States to England is surprising. A recent example of it, and the prompt rebuttal made by the publication of the facts, is found in the following comment of the London *Economist* on the part of Secretary Gage's report dealing with our exports:

"Now, of course, there is no denying the fact that in certain branches of manufacture the United States have lately been competing with greater energy and with considerable success in foreign markets. That success, however, has in part been at the expense of home consumers, who have been called upon to pay prices high enough to enable the manufacturers to earn at home profits sufficient to admit of prices being cut abroad. It is asserted, too, although with what justice we cannot say, that in order to lessen the cost of manufactures for export the wages of the workmen have been cut. Thus we read in the *American*: 'The Baldwin Locomotive Works, it is reported, pays 12 per cent less wages to the men when working on foreign orders, than when working on domestic, and the shoe manufacturers embarking in the export trade pay 20 per cent less wages to the men when making shoes for the foreign trade than when making shoes for the domestic trade.' This is a phase of the development of the foreign trade to which Mr. Gage did not allude. But a more important aspect of the matter is, that while proclaiming their ability to compete with and beat their foreign rivals in neutral markets, the manufacturers of the States still demand to be protected at home, where their natural advantages are of course greater, against those same rivals, by heavy import duties."

The attention of Messrs. Burnham, Parry, Williams & Co., of the Baldwin Locomotive Works, Philadelphia, having been called to the article, that firm gave out the following statement for publication:

"In the London *Economist* of Dec. 10, 1898, page 1760, it is stated that the Baldwin Locomotive Works pay 12 per cent less wages to their men when working on foreign orders than when working on domestic. This statement is inaccurate and misleading. It is the practice of the Baldwin Locomotive Works, on any large block of locomotives, to make special rates of wages, based upon the fact that the tools can be set for the entire lot of locomotives, and, therefore, better time can be made upon them than on locomotives of various classes requiring re-setting of machine tools for each engine. This system, however, is not confined to foreign locomotives, but is pursued with reference to domestic work. It is not permitted to operate to the disadvantage of the workmen, because their aggregate wages will, in such orders, be at least as great or greater than at the higher rates per engine, which, however, require more time in preparation. This matter is merely one of shop administration, and, if fairly stated, cannot possibly be of interest as bearing upon foreign trade."

THE Drake & Stratton Co., of Pittsburg, who have done much of the stripping work on Mesabi range iron properties, have just received a Government contract through the War Department, for the construction of a dock at Havana, Cuba, and a short railroad to Morro castle, costing together about $500,000. The company has already sent 500 laborers and two shiploads of machinery to the island, and the work will be completed by May. A high pile dock 60 feet wide and 300 feet long will be built at the mouth of the harbor, near La Punta battery and opposite Morro castle, and from this a railroad will be constructed, encircling the harbor to the castle. The United States Government, it is said, intends equipping and fortifying Morro castle, with the heaviest and most improved ordnance, and will probably rebuild and improve the castle eventually. The dock will also be used to land troops.

AN order has been given the Schoen Pressed Steel Co., Pittsburg, for 1,000 steel freight cars for the Pittsburg, Bessemer & Lake Erie Railroad, of which 300 will be of the usual hopper type for ore and coal, and 700 will be gondola cars for general merchandise of a design not heretofore made. The capacity will be equivalent to 80,000 pounds of lumber, the cars weighing from 28,000 to 30,000 pounds each.

EXPERIMENTS IN MELTING IRON.*

BY EDWARD KIRK.

In visiting different foundries years ago, when the management of cupolas was not so well understood as at the present time, we found that there were many opinions held by foundrymen as to the point in a cupola at which the melting of iron actually takes place. Some foundrymen claimed that melting was done from the tuyeres to the charging door; others that iron was only melted in front of the tuyeres by the blast and flame, on a principle similar to melting in an air furnace; and still others claimed that iron was only melted at a short distance above the tuyeres. These various opinions led to different ways of charging or loading cupolas. In some foundries 100 or 200 pounds of iron were put in on the bed, then one or two shovels of fuel, then more iron and fuel in the same proportion, until the cupola was filled or loaded to the charging door. This mixed the fuel and iron together, and cupolas were charged in this way to melt from the tuyeres to the charging door. In other foundries from five to twenty hundred weight of iron were placed on the bed and a layer or charge of fuel placed upon it to separate it from a second charge of iron of a similar weight; which was again covered with a second charge of fuel to separate it from the third charge of iron, and the cupola in this way filled. This charging was done upon the theory that a cupola only melts at a short distance above the tuyeres. Foundrymen who were of the opinion that the iron was melted by the flame and blast charged their cupolas in a similar way, but made the charges of iron light and those of fuel heavier, using an extravagant amount of fuel for each heat.

To learn definitely at what point iron is really melted in a cupola, and also to ascertain something in reference to a number of points in melting, on which we had found there was a wide difference of opinion among foundrymen, we constructed a small cupola with a light sheet iron casing and a thin lining through which tuyere and other holes could be easily cut and closed when not required. This cupola we connected with a Sturtevant fan placed a short distance away. The fan was entirely too large for the size of the cupola, but it was arranged to regulate the volume of blast by increasing or decreasing the number of revolutions of the fan. On the blast pipe, near the cupola we placed a very accurate steel spring air-gauge to ascertain the exact pressure of blast in each experimental heat. The cupola was 18 inches diameter inside the lining, and we first put in two round tuyeres of four inches diameter and placed them on opposite sides of the cupola, 24 inches above the bottom.

The first experiments in this cupola were for the purpose of learning at what point in a cupola iron melts, and at what point it melts first. We procured a number of small bars of No. 1 soft pig iron and placed 10 of them, one across an other, in the cupola, six inches apart from center to center, and fastened the ends of each pig in the lining so that they could not settle with the fuel as it burned away. At the ends of each pig we removed the brick lining and filled in the space between the ends of the pig and casing with fireclay, and through this clay and the casing made a small hole through which the heat and blast would escape as soon as the iron melted and fell out of the lining. The first bar of iron was placed three inches above the bottom, and the others at intervals of six inches. When they had all been put in place the bottom door was put up, a sand bottom put in and the fire started in the usual way. As soon as the fire burned up the cupola was filled with coke to the charging door, which was six feet from the bottom, and the blast put on. The fan was run very slowly during the heat and the air-gauge showed less than one ounce pressure of blast in the pipe at any time during the heat, and the greater part of the time showed no pressure at all. We attributed the light pressure of blast to the fact that no iron was placed in the cupola but the 10 bars of pig iron, and the blast escaped freely through the fuel. The pressure of blast would probably have been greater if the fuel had been heavily weighted down with charges of iron closely packed in the cupola. The tap hole was made small and not closed during the heat, and the iron permitted to run out as fast as melted and a note made of the time at which it melted. Iron first appeared at the tap hole in three minutes after the blast was put on, and continued to flow freely until one pig was melted, as was shown by the weight of the iron when cold. The pig melted was the one placed six inches above the top of the tuyeres, as indicated by the escape of the blast from the holes placed in the casing at each end of the pig. After this pig had melted there was a cessation in the flow of iron from the tap hole for about three minutes, when it began to flow again and flowed freely until another pig was melted. The pig melted this time was the one placed 12 inches above the tuyeres, as indicated by the small holes at the end of the pig. There was then a dribbling of iron from the tap hole for a short time, when it ceased altogether; but the blast was kept on until the appearance of the flame at the charging door indicated that the fuel was all burned up, and the bottom was then dropped.

When the cupola cooled off it was found that none of the four bars placed below the tuyeres had been melted or bent, and they showed no indications of having been subjected to an intense heat. The fifth bar, however, showed such indications and was partly melted, but was still in place. This bar was placed across the cupola almost on a level with the tuyeres, and at a point where the blast met in the center of the cupola from the two tuyeres. The iron that dribbled from the tap hole, as mentioned above, was melted from this bar. The sixth and seventh bars had melted as indicated by the escape of blast from the small holes in the casing at the ends of each bar and were entirely gone. The eighth bar was badly bent and showed evidence of having been subjected to an intense heat, but was not melted at all. The ninth and tenth bars were in place and showed less signs of having been highly heated than the eighth bar. The iron from the two pigs melted was a shade harder than when in the pig, and the iron from the pig partly melted was two or three shades harder, showing that iron melted very slowly or burned off was hardened in the process, and we afterward found this to be correct in the regular way of charging a cupola. This heat showed that with a light blast the cupola melted only from about the top of the tuyeres to 12 or 14 inches above the tuyeres.

From the next heat the two bars melted out were replaced by new ones, and the bent one was also removed and replaced by a straight one. The cupola was made up and fired in the same manner as in the former heat, and filled with fuel to the charging door. The same sized tuyeres were use and the speed of the fan increased so as to give a four-ounce pressure of blast in the blast pipe, as indicated by the air-gauge. In this heat, as in the former one, the iron placed below the tuyeres did not melt, and the bars placed above the tuyeres at different heights melted at different times. The sixth bar placed six inches above the top of the tuyeres was the first to melt. Then in a few minutes later the seventh bar melted, and still a few minutes later the eighth bar, placed 18 inches above the tuyeres. These three bars melted rapidly after they began, and were melted within a few minutes of each other. The iron from the first bar melted was a little dull, but the iron from the other bars was very hot. There was no dribbling of iron from the tap hole after the pigs were melted, as in the former heat, and one pig placed higher in the cupola, was melted in this heat. There was no fuel placed in the cupola after the blast was put on, and when the fuel required to fill it to the charging door or about 12 inches above the top of the last pig, was all burned out, the bottom was dropped and the cupola permitted to cool off. When we went in to examine it, it was found that the fifth bar, placed opposite the tuyeres, which had to some extent melted in the former heat, showed no change and had not been subjected to so high a temperature in this heat. The sixth, seventh and eighth bars had been melted entirely out, as indicated by the escape of the blast through the small holes in the casing at the ends of each bar. The ninth bar was in place, slightly bent, and showed indications of having been subjected to a higher temperature than during the former heat. The tenth bar at that point showed no change from increase of heat. From this heat we learned that directly in front of the tuyeres and just above them, the heat was decreased by a stronger or greater volume of blast, and the melting temperature was raised to a higher level in the cupola, for the heat had been decreased at the fifth bar to an extent that pre-

* From a forthcoming work on "Cupola Practice" by Dr. Edward Kirk, of Philadelphia.

vented it from melting at all, and increased at the eighth bar to so great an extent that it was readily melted.

For the next heat we arranged the bars and cupola in exactly the same way, and increased the speed of the fan to give an eight-ounce pressure, as shown by the air-gauge. The melting in this heat was practically the same as in the last one just described. We had anticipated that the melting temperature would be raised in the cupola by the increase of blast, and were very much disappointed when it was found that the results were the same as with the four-ounce pressure of blast. After thinking the matter over, it occurred to us to put on the blast without charging the cupola and test the air-gauge with different speeds of the fan. In doing this it was found that with the fan running at the same speed that showed eight ounces pressure on the gauge, when the cupola was in blast, the gauge showed six ounces pressure when the cupola was not in blast. We at once concluded that the tuyeres were too small to permit so great a volume of blast to pass through them, and the pressure of blast shown by the gauge was due to the smallness of the tuyeres, and not to the resistance offered to the blast by the stock in the cupola.

Since making this discovery, we have seen a great many cupolas when in blast show a high pressure of blast on the air-gauge when the pressure was almost wholly due to the size of the tuyeres and very little blast was going into the cupola.

After making the discovery that the tuyeres were too small to admit to the cupola the volume of blast produced by the fan, we placed two tuyeres in the cupola, four by six inches, laid flat. The tuyeres were made of this shape to increase the tuyere area and at the same time neither raise the top of the tuyere nor lower the bottom, so that comparison of results in melting could be made with the former heat without rearranging the bars placed in the cupola.

For the next heat we replaced the bars, melted out and made up, and charged the cupola as before and ran the fan at the same speed that had shown eight ounces pressure on the gauge with the small tuyeres. The result was that the gauge only showed a pressure of four ounces of blast. The sixth bar placed six inches above the tuyeres, which had been the first to melt in former heats, was not melted at all in this heat, and the seventh, eighth and ninth bars were melted in the rotation named at about the same time apart as in former heats. The tenth bar was not melted, nad none of the bars below the tuyeres were melted. The iron from the ninth bar, which was placed 24 inches above the tuyeres and was the last to melt, was accompanied by a good deal of slag as it flowed from the tap hole, and the iron when cold was white hard, although it was No. 1 soft pig iron when placed in the cupola. The slag and hardness of the iron we attributed to the strong or large volume of blast used in this heat, as there had been no hardening of the last pig melted in former heats with the lighter blast. But this pig had remained in the cupola unmelted during the three former heats and been subjected to the heat of the cupola, and it was afterwards found that the hardness and slag were due to the roasting and burning of the iron in these heats, and not to the strong blast as at first supposed. In this heat the melting temperature was raised to a higher level in the cupola, but only three bars were melted as before at a lower level.

For the next heat we placed two more tuyeres in the cupola at the same level and of the same size as those used in the last heat, and arranged the cupola as before with a view to melting the tenth or top bar. The spread of the fan was the same as in the last heat, in which the gauge showed four ounces pressure of blast with two tuyeres. In this heat with double the tuyere-area, the gauge indicated a pressure of about one ounce, showing that the tuyere was still too small in the last heat to permit the blast to escape freely from the blast pipe into the cupola. We were standing near the spout during this heat with our watch and note-book in hand, waiting to time the first appearance of iron at the tap hole and thinking it was a long time in coming down, when our assistant reported there was no flame or heat at the charging door, and the fire must have gone out. We at once examined the charging door and found that nothing but cold air was coming up. We then stopped the fan and removed the tuyere pipes, and found there was no fire in the cupola at the tuyeres. The front was then removed and plenty of fire was found in the bottom of the cupola, which immediately brightened up. The fire had been well burned up as we supposed, above the tuyeres, before the blast was put on, and it had not been on more than 15 minutes. We were not satisfied with the results in this heat, and as the fire showed signs of burning up when the front was out and the tuyeres were opened, it was determined to let it burn up and try it again with the strong blast. After the fire had burned up until there was a good fire at the tuyeres and we were quite sure the fuel was on fire to 18 or 20 inches above the tuyeres, we put on the same volume of blast as before and watched the results at the charging door. At first the blast came up through the fuel quite hot, but the temperature gradually decreased until it became cold, and it was evident that the large volume of blast had put out the fire, and this was found to be the case when the tuyere pipes were removed.

When the bottom was dropped there was fire in the bottom of the cupola, and the coke around the tuyeres showed that it had been heated, but the coke in the upper part of the cupola showed no signs of having been to any extent heated.

The fuel used in this heat was hard Connellsville coke in large pieces. Large cavities were formed under the bars of iron supported by the lining in charging. The coke was not weighted down with iron in the cupola, and the blast escaped freely through the crevices between the large pieces.

We afterward made a heat in this cupola with the same tuyeres and blast, and charged the cupola in the regular way. The iron melted in this heat was pig and small scrap, that packed close in the charges and did not permit the blast freely to escape through the fuel. The gauge in this heat showed a blast pressure of three ounces and the fire was not blown out, but the cupola did not melt so well as with a less volume of blast, and the iron was harder.

These heats showed that iron is not melted in a cupola by the blast and flame of the fuel; for if it were, the bars directly in front and over the tuyeres, where the blast was the strongest, would have been melted first and been the only ones melted. But the one in front of the tuyeres was not melted by a mild blast, and the one just over the tuyeres was not melted by a strong blast.

The failure of the sixth and tenth bars to melt in the same heat, showed that iron is not melted in a cupola all the way from the tuyeres to the charging door, as it was years ago supposed to do by most foundrymen, when the fuel and iron were mixed in the cupola in place of being put in in separate charges, as is now commonly done.

The raising of the melting temperature to a higher level in the cupola by increasing the blast, showed that there is a certain limited melting space or zone in a cupola in which iron melts, and that this melting zone may be raised or lowered by an increase or decrease of the volume of blast. However, the depth of the melting zone is not increased by a strong blast, but the zone is placed higher in the cupola. It was also shown that iron cannot be melted in a cupola outside of this zone either above or below it, for the bars placed above and below it were not melted with either a light or a strong blast. The putting out of the fire in the cupola by a very large volume of blast and the subsequent poor melting done with a large volume of blast when the cupola was charged in the regular way, showed that too much blast may be given to a cupola and the iron thereby injured.

INVOLUNTARY bankruptcy proceedings have been begun in the United States District Court, Cleveland, against Coe, Powers & Co., of Findlay, O. who went into a receiver's hands early in the year. The members of the firm are Henry L. Coe, of Findlay, B. F. and E. C. Powers and Geo. I. Needham. Messrs. Needham and B. F. Powers are officers of the Garry Iron & Steel Roofing Co., Cleveland. The petitioners in the action are Pickands, Mather & Co., Cleveland; E. D. Nickerson, receiver of the Kellogg Weldless Tube Co., and Harbison & Walker, their claims being $1,632.69, $3 826.21 and $382.38 respectively. It is alleged that the liabilities of Coe, Powers & Co., when they went into a receiver's hands, were admitted to be $60,000, and the assets only $15,000; further, that various mortgages have been given by the defendants, some of these to persons to whom they were not indebted, and to the detriment of their creditors. It is asked that these transfers be declared void. Coe, Powers & Co. operated the plant of the Kellogg Weldless Tube Co. at Findlay.

THE WESTERN FOUNDRYMEN'S ASSOCIATION.

The regular monthly meeting of the Western Foundrymen's Association was held at the Great Northern Hotel, Chicago, Wednesday, Dec. 21, at 7:30 P. M. The attendance was small, owing to the inclement weather and the proximity of the holidays.

The regular order for the evening was the reading of the following paper by Max H. Wickhorst, engineer of tests, C., B. & Q. R. R. Co., Aurora, Ill., on

Porous Castings and Occluded Gases.

Porosity and blow holes in iron, steel, brass and bronze castings, are generally due to occluded gas. To start with, I will explain somewhat fully what occluded gas is. Various molten metals, such as copper, silver, iron, have the power of dissolving different gases, such as hydrogen, sulphur dioxide and carbonic monoxide. These gases dissolve in the molten metal just as air dissolves in water. If a glass of water is drawn and allowed to stand in a warm place, the air bubbles will collect along the sides of the glass, and if water is frozen the ice formed will contain air bubbles, due to the dissolved or "occluded" air liberating itself at the time the water freezes, or sets, or passes from the liquid to the solid state. So, also, if molten metal contains occluded gas, the gas shows no tendency to escape while the metal is in the molten condition; but as soon as the metal starts to set, the gas starts to liberate itself and assumes the gaseous state, forming air bubbles or blow holes throughout the mass.

The gases which may be occluded, or dissolved in molten metals, are hydrogen, sulphur dioxide and carbon monoxide. The two other gases which are generally present when metals are melted, namely, carbon dioxide or carbonic acid gas, and water vapor, probably do not dissolve in molten metals.

HYDROGEN INTRODUCED IN CASTING BRASS AND BRONZE.

Brass and bronze are most frequently rendered pourous by hydrogen; bronze containing little or no zinc being specially liable to be defective from this gas. Hydrogen is a very light, inflammable gas. It weighs only about one-fourteenth as much as an equal volume of air. It is very inflammable, and is an important constituent of the fuel gas known as "water gas." The product of its combustion in air is water. The hydrogen gets into the metal by the decomposition of the water of the mold, when the metal is poured too hot. Water is a liquid formed by the chemical union of the two gases hydrogen and oxygen, in the proportion of two volumes of hydrogen to one of oxygen, its formula being H_2O. Water is liquid at ordinary temperatures, and becomes a vapor at 212 degrees F.

When bronze is poured into a green sand mold much above the proper temperature, the metal does not set right away but remains liquid in the mold It decomposes the water of the mold, separating the water into its constituent elements, oxygen and hydrogen. The metal combines with the oxygen, forming oxide. If zinc or aluminum are present, these combine with the oxygen, forming an oxide which comes to the top and separates from the metal. If no deoxidant such as zinc, aluminum or phosphorus is present, the oxygen combines with the copper, forming oxide of copper, which remains mixed with the rest of the metal, and in the fracture of such metal it forms red and green colored spots.

The hydrogen of the decomposed water, however, does not form any chemical combination with the metal. But the molten metal dissolves it very readily, the hydrogen being absorbed without having its chemical nature changed. While the metal is still molten the hydrogen remains quietly in the metal, but as soon as the metal begins to set, the hydrogen tries to liberate itself, going back into the gaseous state and forming bubbles throughout the mass, and causing a porous casting. Such porosity does not show itself on the surface of the casting, but can be seen only by machining off the skin, or chipping into it, thus getting into the body of the metal. This is as would be expected, since gas bubbles start to form only after the skin is set.

Brass and bronze containing fluxes such as zinc, aluminum, manganese or silicon are not apt to be porous from decomposition of the water of the mold, since the skin of oxide which these form as soon as air gets at the metal, forms a lining along the inside of the mold which prevents any communicaton between the molten metal and the moisture in the mold. Bronze which has been fluxed with phosphorus, that is phosphor-bronze, however, is very apt to be rendered porous due to hydrogen obtained by decomposition of the water of the mold. Phosphorus combines with air or oxygen, going off in the form of a white smoke, and leaves the surface of the metal perfectly clean. The molten metal and the moisture of the mold come in direct contact, with the result that the moisture is decomposed, the oxygen combining with some phosphorus going off as white smoke and the hydrogen becoming occluded and afterwards causing porosity. This is a result which is actually frequently the case where phosphor-bronze is poured at too high a heat. To corroborate the above explanation of the metal decomposing the water of the mold, and thus introducing hydrogen into the metal, I have made the following experiment: Melt about 50 lbs. of phosphor bronze, composed of about 10 per cent tin, one-half per cent phosphorus and the rest copper and get it very hot. Pour a small casting with this, say a two-inch round rod, six inches long, in a green sand mold. The metal will remain quietly in the mold a short time, but after one or two minutes it will start to rise back through the gate, due to the hydrogen which had been absorbed liberating itself, assuming the form of bubbles and thus taking up more room. And the metal is then of necessity forced back through the gate. If this casting be broken when cool, it will be found to be porous, and the gate, especially, will be honeycombed.

After pouring the first casting, pour a little of the metal into an iron ingot mold and when this has cooled sufficiently, cool off the metal in the crucible by stirring the cooled ingot into it till it has been cooled down to a proper pouring temperature. Then pour another casting similar to the first in every respect, and it will be found that the metal runs into the mold quietly and remains there. When this casting is broken it will be sound. This experiment proves that merely getting the metal very hot does not spoil it for making good castings, but that when poured at this high temperature, a reaction goes on with the materials of the mold which produces the bad result, as regards porosity.

HYDROGEN PRESENT IN THE INGOTS.

The foregoing deals with the presence of hydrogen due to faulty handling of the metal by the molder. Most of the phosphor-bronze used is bought in ingot form, and a great deal of the material on the market is already defective from the presence of occluded hydrogen, and will give porous castings when used, and the explanation of the presence of the hydrogen is as follows: Phosphor-bronze is usually made by melting the copper, tin and lead and then introducing the phosphorus by means of a cup shaped instrument called a retort or phosphorizer. Phosphorus is a wax-like substance and comes in about the shape and size of a candle. It melts at about 110 degrees F., and catches fire with the utmost readiness, so that it has to be kept under water. The phosphorus is put into the retort, either moist or wrapped in moist paper, and the retort then plunged into the molten metal, mouth downward. The phosphorus melts and combines energetically with the metal. The moisture which is present is also decomposed in the presence of the molten metal and the high heat. The oxygen combines with the phosphorus going off as oxide of phospohrus in the form of a white smoke. The hydrogen dissolves in the molten metal and when the metal is poured into ingots it cools so rapidly that the gas has no chance to escape, but remains fairly evenly diffused throughout the ingot. Whether an ingot is defective from the presence of occluded gas, can be told by the appearance of its upper or open surface. An ingot free from occluded gas will have its upper surface concave and shrunken in, and may even be somewhat cracked due to shrinkage. Another ingot, however, containing occluded gas will have a convex surface and be bulged out. This is because the gas, while the ingot is cooling, makes an attempt to get away, and in doing so bulges out the ingot.

The introduction of gas into phosphor bronze in the manufacture may be avoided by having the phosphorus perfectly dry. As ordinary phosphorus cannot be dried without danger of igniting, the phosphorus is first put into a dilute solution of sulphate of copper or blue vitriol for half an hour

or longer. This deposits a coating of copper on the phosphorus which allows it to be dried without danger of igniting, so long as the copper coating remains intact.

I read a paper before the Western Foundrymen's Association in March, 1897, which explains in detail the manufacture of phosphor-bronze. Phosphor-bronze made with dried phosphorus will not contain any occluded gas.

ACTION OF OCCLUDED GAS IN PHOSPHOR-BRONZE BEARING METAL.

In phosphor-bronze metal the effect of occluded gas is detrimental and serious in that it causes hard spots in places in the metal. This metal has usually the following composition: Copper, 79.3 per cent; tin, 10.0 per cent; lead, 10.0 per cent; phosphorus, .7 per cent.

In this mixture, the tin combines chemically with some of the copper, forming a copper-tin compound, which is gray in color, very hard and has a low melting point. The bronze therefore contains no free uncombined tin. The lead forms no chemical combination but remains simlpy mixed with the rest of the ingredients. The phosphorus probably combines with the lead to make phosphide of lead. The excess of copper not necessary to combine with the tin remains as free uncombined copper.

So that in the crucible, the molten metal consists of free uncombined copper, copper-tin compound, lead and phosphide of lead. When bearing phosphor-bronze which contains considerable occluded hydrogen gas is cast, it flows into the mold quietly and remains quiet for about one or two minutes. If the gate of the casting be watched it will be noticed that after about two minutes, little beads of metal, with the appearance of melted lead, come oozing through the top crust of the gate and stand there like drops of sweat. These beads are very hard and cannot be filed, and are gray in color. If the casting be now cleaned, nothing peculiar can be seen on its surface, but if the top of the casting be chipped into, or the skin machined off, or the casting broken in two, it will be noticed that the casting is porous and full of blow-holes. If the gate be broken in two this will be specially honeycombed. If the fracture be examined it will be noticed that the gas cavities are all bright yellow, and that the gray portions of the copper tin compound and the lead are perfectly sound and solid. This shows that it is the free copper in the bronze which dissolves or occludes the gas. After the metal had been poured, the constituent copper started to set first, it having the highest melting point, leaving the copper-tin compound and the lead still liquid.

While the uncombined copper is setting, it liberates the occluded gas, and this in trying to get away, forces the still liquid copper-tin compound and the lead ahead of it, and causing the beads to come out through the gate. I have analyzed some beads obtained as above described from a bearing metal phosphor-bronze of the above composition, with the following results:

	Bead.	Body of Bronze about
Copper	74.66%	79.5%
Tin	22.15%	10.0%
Lead	3.06%	10.0%
Phosphorus	.37%	.5%

It will be noticed that these beads consist practically of a copper-tin compound, this having taken along with it some lead and some phosphide of lead. There is not much lead present, probably because as lead mixes only to a small extent with the other materials and is much heavier it settles away and remains behind. If an engine driving brass be broken it will be noticed that although most of the bubbles collect near the top of the casting, some collect near the surface even at the bottom, which is usually the bearing face. As the gas in collecting into bubbles pushes the hard copper-tin compound ahead of it, as we have seen above, hard spots form in the brass. As the hard spot takes all the weight of the bearing, excessive friction is created and a hot brass ensues.

METHOD OF GETTING RID OF OCCLUDED GAS IN INGOTS.

Occluded hydrogen in ingot metal can be expelled by introducing oxygen or air into the molten metal, thus oxidizing out the hydrogen.

This can be done only by first oxidizing out all the phosphorus, as this takes the oxygen first. This experiment may be made to demonstrate the principle involved. Melt about 70 lbs. of phosphor-bronze, which has given trouble from occluded gas, and pour a casting from it. This will show that this particular heat is so defective. Then place back in the fire and when melted add sufficient oxide of copper to oxidize all the phosphorus and still have a slight excess left. Then re-phosphorize the metal and add enough lead and tin for the copper introduced and pour another casting. This will be found to be sound and free from porosity. I have made an experiment similar to the above, and while the original metal gave a very porous casting, the metal after treatment gave a perfectly sound casting. Commercially, this method, or any method involving the same principle, would not be practicable on account of the expense, and probably the best way to dispose of such metal, if one has such metal on hand, would be to mix it with enough good metal and use it where a slight porosity will do no harm.

SULPHUR DIOXIDE GAS.

So far I have been dealing with hydrogen gas. Another gas which frequently causes porosity in brass castings is sulphur dioxide gas, chemical formula of which is SO_2. It is a gas of pungent odor, being the same gas which is formed when sulphur burns, and is used for fumigating purposes. It is also sometimes used in refrigerating machines. The different metals which go to make up brass may all contain sulphur. When brass is made of some metal containing sulphur, as soon as the metal comes in contact with air the sulphur combines with oxygen of the air, forming sulphur dioxide gas, which then acts in all respects similar to hydrogen. As I have already expanded somewhat fully on how hydrogen acts, it will not be necessary to explain further about the action of sulphur dioxide gas. I was foreman of the brass foundry of the C., B. & Q. R. R. for a while, and not long after taking charge of the foundry we had one or two heats of small miscellaneous brass castings show porosity when the casting was broken.

The brass consisted of copper, zinc, lead and tin. On looking over the list of materials used, it seemed probable that the trouble lay in the zinc containing sulphur. The zinc used consisted of old worn out battery zincs which had been melted up under charcoal and cast into small ingots. Now old zincs have considerable sulphate of zinc adhering to them, and when this is heated under charccoal, some of it is reduced to sulphide of zinc, which remains in the metal. When the metal is melted and poured containing such zinc, the air acting upon it, the sulphur has a chance to combine with some oxygen, forming sulphur dioxide and acting as before explained. The zinc was then separately melted without any covering of charcoal, exposing it freely to the air, and then recast into ingots. When only a limited amount of air combines with the sulphur, sulphur dioxide is formed, going off as gas, as probably zinc does not occlude this gas. When this retreated zinc was used, the castings were perfectly sound without any porosity.

CARBONIC OXIDE OR COAL GAS IN STEEL.

Carbonic oxide or coal gas has a chemical formula CO. This gas is also a constituent of "water gas." It is an inflammable gas, burning with a hot light blue flame. It is odorless but very poisonous. It is the poisonous gas given out by hard coal stoves, known as coal gas.

As far as my observation goes, brass and bronze are not liable to be defective because of this gas, as I have not seen a case whose porosity could be positively attributed to it. The porosity of steel castings, however, seems to be frequently due to carbonic monoxide gas. When a heat of steel has been heated till the carbon is low and the silicon reduced below a certain point, the castings made from such a heat are apt to be filled with holes. The explanation for this seems to be that as long as silicon and manganese are present these combine with oxygen and remove it entirely from the metal. As soon as these are reduced very low, some of the oxygen combines with the carbon forming carbon monoxide gas, which then renders the metal "lively." If now a little aluminum is added this takes the oxygen and the metal is again made "dead." I am not a steel man and would hardly be bold enough to offer any theory concerning steel, if it were not for the fact that there is practically no literature on this occluded gas question, and also that what stray statements one may run across on this subject, show that the author generally has a wrong ideaof the nature of the action of occluded gases. For instance: Campbell in his book on Structural Steel, in the

chapter on steel castings, page 373, in speaking of aluminum and silicon versus manganese, says: "Another function which may play a part in the operation is the increase in capacity to dissolve or occlude gases, and as far as the value of the casting is concerned, this will be equivalent to destroying them." The idea evidently being that the aluminum or silicon has such an effect on the gas, that when the metal passes from the liquid to the solid state, the gas likewise goes from the liquid to the solid state. We have seen, however, that when metal contains dissolved gas, the gas goes from the liquid to the gaseous state as the metal solidifies.

Discussion.

L. L. Smith, foreman C. B. & Q. R. R. brass foundry (Contributed): The paper of Mr. Wickhorst treats of a subject which so far as I have been able to discover, is practically untouched in metallurgical literature. Considering the importance of the phenomenon of occluded gases and the opportunities of gases for giving trouble, especially in alloys of copper, the fact that the subject has received so little attention from metallurgical writers is somewhat surprising. In the refining of copper, the operation of poling makes very manifest the possibility of gas being occluded. When the copper has reached the stage when it is to be purified by poling, the metal is practically free from metallic impurities, but it contains oxygen in the form of cuprous oxide which is held in solution in the metal. To reduce this cuprous oxide to metallic copper, the surface of the molten mass is covered with a layer of charcoal, and a green sapling or pole is plunged into the metal. The gases given off by the burning pole causes the copper to bubble and sputter violently. The gases, in permeating the metallic mass, come in contact with all parts of the copper and assist in reducing the cuprous oxide. If the poling has not continued long enough, a portion of the oxide remains unreduced, the copper is said to be "underpoled," and a test ingot dipped out will show upon cooling, a concave upper surface. If, however, the poling has been carried on beyond a point where the oxides have all been reduced, the gases having no oxygen to combine with will be occluded by the copper. The metal in this condition is said to have been "overpoled." A test ingot upon cooling will show a convex upper surface due to that peculiarity of copper which in the molten state has occluded gas and upon cooling has released it in bubbles which cause the ingot to swell.

I recently had occasion to melt some copper which had occluded sulphur dioxide, and upon being poured out into an ingot mold, the upper surface of the ingot swelled up like the top of a loaf of bread.

In copper refining, the cure for overpoling is quite simple, the copper being allowed to reoxidize, after which it is repoled up to the proper point. After copper has entered an alloy such as phosphor-bronze, if the bronze having been deoxidized by phosphorus occludes gas, the gas cannot be so simply eradicated as with copper in the refining furnace. As indicated in Mr. Wickhorst's paper, the alloy can be re-oxidized by adding cuprous oxide, and again de-oxidized by phosphorus, but this, as he points out, is a somewhat expensive process. A description of some inexpensive commercially practical method of getting rid of occluded gases will certainly form a welcome addition to metallurgical literature. It is best, however, to seek means of preventing the occlusion of gas, for in this case, as in many others, "an ounce of prevention is worth a pound of cure."

An informal discussion of the paper was had, and Mr. Wickhorst gave a very interesting general talk on the manufacture of brass and bronze castings. It was decided to have the paper presented before the January meeting of the association, to give absent members a chance to hear and discuss it. The meeting then adjourned.

THE O. C. White Co., 65 Beacon st., Boston, manufactures a device for incandescent lamps. It is provided with ball and socket joint, so that it can be put in any position, and it is held in place by a screw clamp. It is in use at the Boston & Albany repair shop at Allston, Mass., and is being introduced in other plants. It is adapted to the needs of machine shops and foundries. In lathe, planer and other work in connection with which a suspended light can be used, it is of great value.

THE RECORD OF MUIRKIRK PIG IRON.

TO THE EDITOR:

I note the article in your issue of Dec. 1 on "Making of Gun Iron and Semi-Steel," and also the article on "Pig Iron for Gun Carriage Work" in your issue of Dec. 15. I was glad to get the information in regard to mixtures in the first article and to notice that Muirkirk pig iron was the base for the cupola castings in the first two mixtures of the same. It is probably not known to you or to the trade generally that Muirkirk pig iron was the first iron to be used successfully in the manufacture of gun iron castings for the United States Government, by melting in the cupola. Such, however, is the fact; and the credit of being able to make gun iron castings in the cupola that would stand the tests of the United States Government for gun carriage work rightfully belongs to Messrs. Robert Poole & Son Co., of Baltimore, Md., and Muirkirk pig iron made by me. This was in 1893. The War Department at first refused to accept cupola iron as gun iron; but when it was fully demonstrated that the iron was fully the equal of, if not better than "air furnace gun iron," they were satisfied.

In the article in your issue of Dec. 15 the impression given to most people would be that Muirkirk iron had been superseded by another iron. Such, however, is not the fact. We have for the past years, and in this year 1898, sold iron to all the parties named in the article, except the Bethlehem Iron Co., and we claim that the base of the product of these firms is Muirkirk and that the other iron mentioned is only used with Muirkirk to cheapen the cost. One of our customers has gone so far as to say that Muirkirk by itself makes a better casting and is worth more money per ton. The great strength and value of Muirkirk pig iron is not a question of a few years, but has been known since the building of the furnace in 1841, or over 50 years. Muirkirk was used during the Civil War for shot, shell and cannon. It was used in the manufacture of the last cast gun iron mortars made for the United States War Department, and was used at the U. S. Navy Yard, Washington, D. C., for the manufacture of cast iron shells until steel was substituted. The tests for these shells were very severe, both as to density and tensile strain, and no iron made in the United States was found its equal for the purpose. It is a fact that owing to the failure in firing, of some of the cast shells made from other irons, an order was issued by Commodore Folger that no iron but Muirkirk should be used for making shells above six inches.

I find on looking over my order book that there is not a year from 1890 that we have not shipped more or less iron to the Watertown Arsenal, although in the article I refer to the attempt is made to convey the impression that another brand is the one iron that is used there for strong work.

The fact is that until a few years ago there was no iron that could compete in any way with Muirkirk pig iron for strength and elasticity, and now there is none that would be preferred at the same price per ton. Iron was made from the ores near here before the Revolution, and cannon and shot were made from these ores by the Americans in that war against England. The remains of the old furnace erected by Major Snowden under a grant from King George are still to be seen. They are on the Patuxent River about three miles from this place. I will send you shortly a new cicular, giving tests and analyses of Muirkirk pig, covering a period of 24 years. The old circular I hand you will show some of the tests but not all. You will notice that all the tests were made from pieces turned down from the pig itself, and not from remelted iron. The test made by the Thomas Iron Co. is, as far as I know, that of the strongest piece of pig ever made. [Two pieces turned to exactly 9-16 at the breaking point, showing 12,580 and 13,040 respectively, these being multiplied by 4 to obtain the given result: 50,320 lbs. and 52,160 lbs. per sq. in., respectively.] I have had charge of and practically owned this furnace for the past 35 years, and know that all the claims I make for Muirkirk pig iron are true and not to be gainsaid. I think I can truly say that I never have lost a customer except on account of price, never on account of quality.

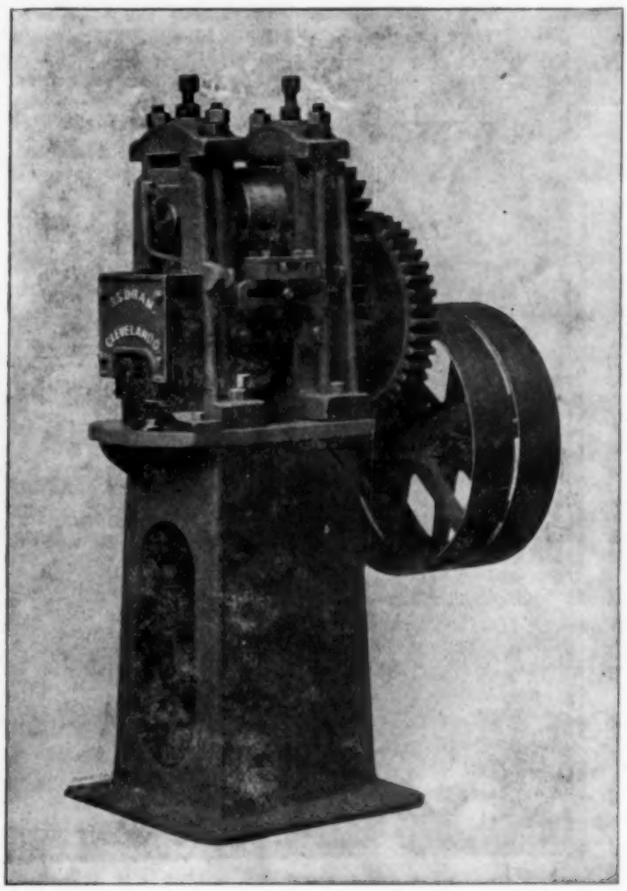
CHAS. E. COFFIN.

Muirkirk, Prince George's County, Md.

THE Lobdell Car Wheel Co., Wilmington, Del., is erecting a steel foundry building 44x132 feet, with lean-to 30x88 feet.

FLARING, PUNCHING AND SHEARING MACHINE.

A combined hoop flaring, punching and shearing machine is manufactured by John S. Oram, of Cleveland, who makes a specialty of barrel machinery. It is in use by iron and steel hoop mills which prepare the barrel hoops so that they are ready for the cooper's use. The machine is strong and compactly built. The rolls are chilled very hard and ground perfectly round and smooth, and are double-geared. The punching arrangement has large wearing surfaces free from small pins or weak points. Punches and dies are made to standard size and are kept in stock. A strong rubber spring is provided under the pressure screw on the top of the bearing, and by its use danger of breaking the machine through the operator's screwing down too hard or through variation in thickness of the iron, is avoided. The capacity is 4,000 to 6,000 hoops a day. The weight is 1,200 lbs.; floor space, 2x3 feet. The pulleys are 22 x 4 inches, tight and loose; the speed, 200 revolutions.



FLARING, PUNCHING AND SHEARING MACHINE.

THE Spencer Automatic Machine Screw Co., of Hartford, Conn., has been adding to its machinery lately, and is now ready to take contracts for special screws or small pieces. The company has had a good demand of late for its specialties.

THE Acme Machine Screw Co., of Hartford, Conn., manufacturer of the Acme automatic screw machines and their products, is enlarging its works with the intention of doubling its capacity. The demand has been much beyond its facilities of late.

IN a pocket-size pamphlet from its Western office, John McLaughlin, Chicago manager of the Andrews Bros. Co., of Haselton, O., gives letters from many users of its Haselton-Scotch and Haselton-strong irons. Views are given of the Haselton Furnace and the Haselton rolling mills.

THE Bessemer steel works at Pueblo, Col., are closed down for holiday repairs.

PERSONAL.

Warner Arms, president of the Falcon Iron & Nail Co., Niles, O., will remove to Chicago in view of his election as third vice-president of the American Tin Plate Co.

Alexander Nimick, for many years a prominent figure in iron and steel manufacture at Pittsburg, died Dec. 20, aged 78. He was in business in Pittsburg at 20. He and his brother, William K., formerly had a large share in the Sheffield Steel Works, of Singer, Nimick & Co., and also in the Sligo Iron Works of Phillips, Nimick & Co. In 1863 he became connected with the Jones & Nimick Mfg. Co., manufacturers of builders' hardware. In 1882 it became the Nimick-Brittan Mfg. Co., with Mr. Nimick as president. Mr. Nimick was also connected with the Standard Nut Co., and was the head of the firm of Nimick & Co., pig metal merchants. He was interested in the Pittsburg Locomotive Works, and was a director of the Oliver Wire Co. During the later years of his life he withdrew from all these business enterprises.

THE Chisholm & Moore Mfg. Co., Cleveland, manufacturers of anti-friction chain hoists, direct differential blocks, electric and compressed air motor hoists, traveling cranes, etc., have issued a pamphlet illustrating the latest developments in these appliances. The addition of traveling cranes to the company's products is an important departure. A view is given of a 10-ton hand power crane, with 22-ft. span. The trucks pass through the web of the I-beam and are securely fastened to it by angle irons and braces, making a very rigid, compact and absolutely safe construction. Every bolt may be removed from the frame work of the crane without materially impairing its strength. The trolley runs on a 16-pound T-rail bolted on top of the I-beam. The bearings of the truck and trolley wheels are all roller bushed. The swivel eye of the trolley carries a 10-ton Moore anti-friction chain hoist. A cut is given, also, of a 3-ton geared yoke trolley, with a 3-ton Moore hoist attached by a close swivel connection.

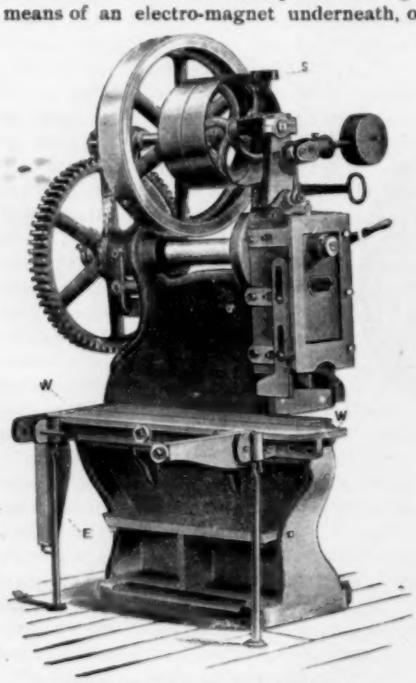
IMPROVED UNIVERSAL PLATE SHEAR.

The universal plate shear, of which a front view is given in the accompanying cut, is manufactured by Bertsch & Co., of Cambridge City, Ind. It is provided with 10 or 16-inch blades and is designed for trimming and slitting ¼-inch to ¾-inch plates. It is arranged also for cutting angle iron, and may be made interchangeable for punching, if desired, with 8-inch to 15-inch throat. The knife-head has a long bearing, being practically self-contained, as with a boiler punch, with sliding head. There is also ample compensation for its wear. The extension side table, which has bracket arms, is provided with friction rolls for easy and convenient shifting of plates. The table can be quickly turned down, as may the extension arms, which can be any desired length. The gearing and pulleys are entirely out of the way. The casting in the rear of the blades is made of extra width for strength and for ample clearance to shift cut metal. The main frame is also provided with a heavy strengthening bolt in the rear of the throat. These shears are manufactured in any size required and with longer blades than those specified above, if desired.

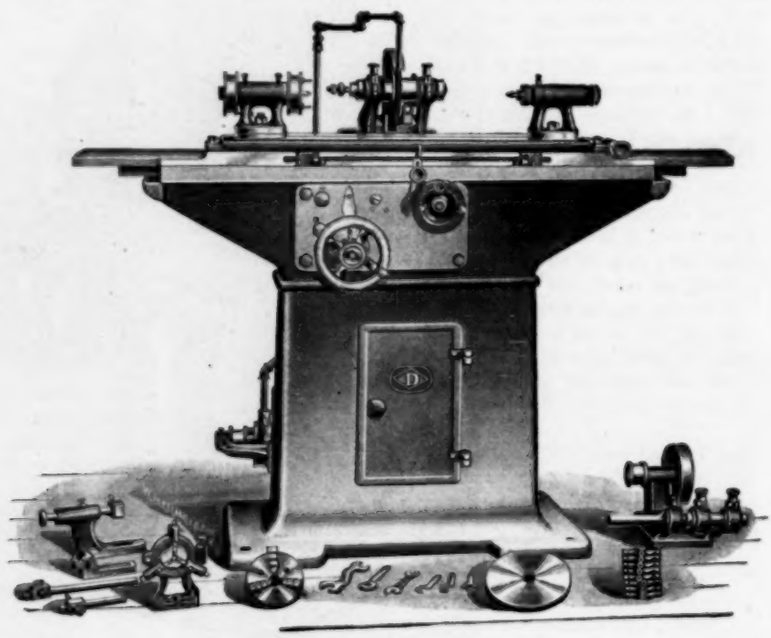
NEW UNIVERSAL GRINDER.

The machine illustrated is a product of the Diamond Machine Co., Providence, R. I., and is from new designs of the manufacturer, and embodying the most recent improvements pertaining to this class of grinding machinery. There are swivels to the head stock, emery wheelshead and table, these swivels being provided with graduations for setting at any desired point. The length of the bed is such that there is no overhang of either head at any point of the travel. Micrometer adjustment for bringing the wheel forward is provided.

By means of the internal grinding fixture, which runs at a speed of about 15,000 revolutions, large or small holes can be ground. Pump and water connections are provided with every machine and ample provision is made for taking care of a copious supply of water. The machine shown has a capacity of 18 inches between centers by 8 inches in diameter. The emery wheel is 8 inches in diameter, ½-inch face. The same company makes a universal grinder as small as 12 inches between centers, and also sizes 30 inches, 40 inches and 60 inches between centers.



IMPROVED UNIVERSAL PLATE SHEAR.



NEW UNIVERSAL GRINDER.

Recent Electrical Devices for Machine Shops.

To hold down to a lecture platform a light iron object by means of an electro-magnet underneath, out of sight, and thus appear to multiply its weight many times over at will—to make it impossible even to lift the object in question, providing the magnet be powerful enough—is an old conjurer's trick which has served on many occasions to mystify the public. Its principle, however, has been applied to several more useful purposes, and one of these, of recent date is embodied in a magnetic chuck, for miscellaneous work, for surface grinding principally, but adapted also for the planer or the lathe. The magnetic effect in this chuck is produced by an electric current circulating in a coil in the interior of the device, and, as this coil is wound, preferably, for 110 volts, the needed current can be taken from any regular electric lighting main in or about a shop. The convenience of the device, especially for small work, is so obvious that it need not be emphasized.

A magnetic holder for an electric incandescent lamp is another electric shop convenience which, no doubt, will be quick to commend itself. The holder is simply a lamp socket containing a small electro-magnet, which will make the whole contrivance stick to any piece of iron or steel with which it may be brought in contact. The coil through which the magnet is energized is within the base of the holder, and the lamp current supplying the energy passes through it on its way to the lamp. In machine and boiler shops, in engine and boiler rooms aboard ship; in fact, wherever light is needed for machine work, the contrivance ought to prove a convenience of the first order.—[Cassier's Magazine for January.

THE Betts Machine Co., of Wilmington, Del., has shipped four horizontal boring machines and two vertical boring mills to De Fries & Co., Dusseldorf, Germany; one horizontal boring machine to Hamilton Machine Tool Co., Hamilton, O.; one heavy frog and switch planer to Hoboken, N. J.; one six-foot boring mill to Bath Iron Works, Bath, Me.

BEST, Fox & Co., of Pittsburg, manufacturers of brass fittings, have received orders during the past few weeks from the Sheffield Traction Co., of Sheffield, Eng., for several thousand dollars' worth of wrought iron steam pipe and fittings. The orders were obtained only after sharp competition from English firms. The Pittsburg Malleable Iron Co. some time ago secured contracts for malleable iron castings from the same traction company.

THE Lukens Iron & Steel Co., of Coatesville, Pa., is at work on an order for 4,000 tons of steel plates, all 26 feet long and one-quarter inch thick, to make about 17 miles of pipe to supply Adelaide, South Australia, with fresh water. The plates go direct to Australia and there will be made into pipes without either riveting or welding, a special process being used.

THE Cambria Steel Co., Johnstown, Pa., is in unusually full operation, with larger output than at any time. The company will make extensive improvements and additions which will very much increase the capacity and it will probably add some new lines of manufacture.

ECONOMIES IN THE USE OF COMPRESSED AIR.*

BY R. P. WHITELAW.

It seems strange that although compressed air has been used chiefly in mines for hoisting, pumping, coal cutting, and various devices for the last 50 years, little or nothing has been done towards making it an economical method—whether on account of the difficulties which have presented themselves in the form of heat or cold, or a general indifference to its use, I am not in a position to say. But I am inclined to think it is the latter, as our greatest engineers and experimenters have lived during that period; and had they devoted the same attention to this subject as they have given to steam and electricity, compressed air would stand on a much higher level than it does to-day, and there would be but little use for electricity.

In about the year 1849 an air-compressor plant was installed in Glasgow for driving an underground air hoist. The compressor, I might say, was a fast-running one, and but little attention was given to cooling devices, and the result was that it had not run many hours before the cylinders and pipes close to the compressor were red hot, and then the report came up from below that the engine had frozen up; this was thought to be a great phenomenon, and was talked about all over the country. The freezing was caused by over-expansion, and yet the difficulty was got over without changing the ratio—by injecting a spray of water into the compressor cylinder the temperature was reduced to such an extent that there was no difficulty in running the compressor. The moisture thus injected was then carried over to the hoist and prevented the freezing up of the exhaust ports. Had the air been dry in the first instance (I might say there is no such thing as dry air), freezing up could not have taken place, and yet it was prevented by still adding more water to it. This may seem strange, yet it was so; for air with a high percentage of water has a much higher specific heat value than dry air, so that in the first place it is more difficult to heat, and in the second it is more difficult to cool.

The practice of injecting water into the compressor cylinder is being carried out to the present day in some of the Scotch collieries, and so long as it will run their engines they are satisfied, and the difficulty for them is ended; a few tons of coal per week is of no importance in their calculations; thus compressed air is, by Scotch coal owners and by many other users, left to work out its own salvation. It is wasteful even to the extent of 50 to 60 per cent, and we only use it where we cannot use steam; that is how compressed air is abused, and I really think there are more abusers than users of it.

When the air is compressed all the work which is done in the compression is converted into heat, and from this it would seem that as soon as all the heat has been got rid of the work done on the air is virtually thrown away, and the air will have no more energy than it had before compression if the temperature is not increased. It is quite true that it has no more energy than it had before compression, but the advantage lies in bringing it into a more available form. The heat of compression increases the volume, and it is, therefore, necessary to have a much larger compressor than if no heat was generated. The first cause of loss of work, then, is theoretically unavoidable, but then theory and practice are very different things, more especially in air compression—for instance, theory says that time plays no part in the heating of air during compression, while practice says the faster you run your compressor the higher the temperature will rise. That is quite true, but in the first instance the heat is lost by radiation, while in the second case we cannot lose it, as it has not time to get away, and this is the task we have to set ourselves to—viz., to get rid of the heat during compression, or, if possible, before compression.

All makers of compressors in giving instructions how to use these machines advise taking the air from the cool or shaded side of the engine room, so that the air will enter the compressor as cool as possible, and, therefore, it will occupy a smaller space and be so much cooler when compressed. You must bear in mind that every five degrees Fahr. you reduce it in this way means one per cent saving. Now the question arises, can this cooling before entering the compressor be extended beyond taking the air from the cool side of the house? It can, and the following method I tried with a new Riedler air compressor that had the advantage of two inlets to the suction-valve chambers, one opening to the engine room and the other could be led uneer the floor. The latter was carried down about 10 feet, and then a drive was cut from there to a distance of about 40 feet, then a shaft was driven down to meet this. An old chimney was put down the shaft and on top of the chimney there was fixed a large spray about three feet in diameter—very little water was used to keep a decent shower going all the time, and the water not only cooled the air but washed away all the dust. The results got from this were more than I expected, as the air was cooled 15 degrees Fahr. showing a saving of about three per cent, and the engine room temperature was 10 degrees Fahr. higher than the outside air, so that I have a right to claim 25 degrees Fahr., of cooling, or effecting a saving of five per cent over taking the air from the warm room. The result was excellent, as the cost of installing the cooler was very small. This inlet cooler could be still further improved upon by having a fan blast to blow along the tunnel, and if compressed air was used any where close by for driving a pump or hammer it could also be exhausted into the tunnel; so you will see that it is possible to effect a further cooling of about 10 degrees Fahr. to 12 degrees Fahr.

Another point that ought to be attended to is the suction valve chamber. With some compressors nothing can be done, but in the present Riedler the arrangement is simply splendid for having a trickling cooler keeping the chamber cool, as working at present the suction chamber is nearly as hot as any part of the machine, and the result is that the air in passing takes up a considerable amount of the heat from the walls, and is expanded just on the point of entering the cylinder. The degree the air is heated at this point cannot be arrived at, but it is just possible that it is something like 20 degrees Fahr. If it were only possible to prevent 10 degrees Fahr. of this amount it would mean that another two per cent added to the five per cent we arrived at previously, would make in all a saving of seven per cent, which is a large item where 500 or 600 horse power is being developed for making compressed air on a plant such as I have made mention of, or, in other words, on a 45-drill plant it would mean a saving in round numbers of £46 per month.

Having done all we can for a single stage compressor, little else can be accomplished unless by injecting a spray of water into the air while it is being compressed. To do this properly it would require an arrangement of tappet valves so as to give it the spray at the right moment If this arrangement was well carried out I believe most excellent results would be obtained. The entrained water would be liberated as soon as the temperature dropped sufficiently, and could be then trapped with an ordinary steam trap.

Jacket cooling is practically of no service except in assisting lubrication of the cylinder, so that little can be gained by jacketing the cylinder and heads and piston, as only a thin layer of the air that comes in contact with the metal surfaces is cooled.

We now come to the staging of the air. This has been the means of already reducing the cost of compressed air by about 20 per cent. Now, what does staging do after all? Well, it simply draws away the heat from the air whilst it is being compressed, and this we have already decided is the great difficulty we have to overcome. Suppose, for instance, air is compressed by an indefinite number of stages, and that each time the air is cooled to free air temperature, what do we attain? Very nearly isothermal compression, and this is what we want to attain so that no loss will take place after the air has left the compressor. The gain is two-fold; first, less power is developed; and, secondly, the air is delivered cold, and will, therefore, have no loss due to reduction in volume, which is the bugbear of compressed air as used at present.

Air expands and contracts as its absolute temperature. For instance, we have two compressors, one a single stage and the other a double stage. The former is delivering air at 500 degrees Fahr., and the latter at 200 degrees Fahr., or say 961 degrees Fahr., and 661 degrees Fahr. absolute. The relative efficiencies are as 961 degrees is to 661 degrees, or the latter has an advantage over the former of 24 per cent. So that I

*Paper read before the Mechanical Engineers' Association of South Africa.

hope you will agree with me that staging and efficient inter-cooling are what is reqiuired to elevate compressed air to a first place for the transmission of power.

Inter-cooling between stages, as carried out at present in many cases, is far from perfect. Inter-coolers are made after the same form as feed water heaters or condensers, with a great number of tubes which are very liable to leakage. The tubes get coated with lime and other matters, which considerably reduce their efficiency. The best result that I know of is a reduction of temperature of from 200 degrees Fahr. to 140 degrees Fahr., while the air, to give full value, should be reduced to at least 72 degrees Fahr., or free-air temperature. I think a method could be adopted whereby the air could be reduced to free-air temperature, and a really simple method, too. I find that air delivered from a single-stage air compressor at a temperature of 470 degrees Fahr. has been reduced to free-air temperature before it has traveled 250 feet through the delivery pipe. This is one of the great drawbacks to the use of compressed air; it is a decided disadvantage, but it might be taken advantage of for inter-cooling. What could be more simple for an inter-cooler than 200 feet of pipes, even if it were made 20 or 30 per cent larger than is actually required? It would be much cheaper in the first place than the ordinary inter-cooler, if it was well laid down in the first instance—there is no reason why it should be looked at again, it would require no circulating water; if it was made large enough there would be no loss due to friction —it is a natural process, while the other is artificial. Any one of you can have a practical demonstration of it by fixing a thermometer to the air main. The pipe should not be buried into the ground, as earth is a good non-conductor of heat, and would give back heat to the air. It should be exposed to the atmosphere, and placed where it would get a free current of air, and should not be exposed to the sun. The present inter-cooler, as I have already mentioned, reduces the temperature to 140 degrees Fahr., which I think is one of the best results that can be obtained, whilst the inter-cooler, already suggested, would reduce the temperature to, say, at the very least, 70 degrees Fahr., or a saving of 14 per cent over the present system of inter-cooling. The figures I have just given refer to second-stage compression, where the air is first compressed to 25-lb. pressure, and from 25 lbs. direct to 80 lbs., with a temperature of about 280 degrees Fahr., from which temperature it is generally reduced to 70 degrees Fahr., a drop of 210, showing a loss of exactly 28 per cent from the time it leaves the compressor until the time it reaches the drills. The above figures work out as follows: 280 gives 741 absolute, 70 gives 531, and 741 : 531 :: 100 : 71.6, showing a difference on the wrong side of 28.6 per cent, which is the actual percentage of loss. This is where better inter-cooling would give the advantage; if the air was delivered at 70 degrees Fahr. less, or 210 degrees Fahr., the actual loss would only be 20 per cent. The remedies for this are three-stage compression and reheating.

First, let us take three stages, and say the second stage raises the pressure from 25 lb. to 60 lb., and the temperature to 120 degrees Fahr., and is again cooled down to free air temperature. It is well known that the temperature rises more rapidly in the early stages of compression than it does in the latter stages. For instance, from atmospheric temperature to 25-lb. gauge it is raised from 80 to 290 degrees, or an increase of 212 degrees Fahr., whilst from 25 to 80 lb. it is raised from 135 to 276 degrees, an increase of 141 degrees. In the first case the pressure is only increased 25 lb., and in the second case the pressure is increased 55 lb. This, I should say, speaks well for three-stage air compression. The initial cost of such a compressor would certainly be much greater, but that would soon be made up in the increased economy. The temperature, as I have already pointed out, by compressing from 25 to 60 degrees would be 120 degrees Fahr. The air is then cooled to free-air temperature and is sent on its last journey to 80 lb.; the temperature would then be increased to about 110 degrees Fahr., and this would be its final temperature. It has then only a drop of 40 degrees Fahr., until it reaches free-air temperature. The loss sustained by this fall in the temperature would then only represent seven per cent, against a loss of 28 per cent with a two-stage air compressor, showing a gain of 21 per cent in favor of three-stage air compression over two stages.

The cost of such a machine would be much greater than a two-stage compressor, so is a triple-expansion engine a great deal more expensive than a compound, but still they are being extensively used, and why? Because the economy in running soon makes up for any extra initial cost. The same argument applies to three-stage air compression.

Continued next week.

INDUSTRIAL SUMMARY.

New Buyers in the Market, and Some of Their Wants :—

[If you are in need of machinery of any description, please notify *The Iron Trade Review*, and we will put you in communication with our advertisers at once.]

E. C. Sherwin & Son, Brandon, Wis., want to communicate with manufacturers of steel or iron pipe suitable for use in culverts.

The Pelton Engineering Co., of Cleveland, is incorporated for manufacturing and dealing in everything pertaining to electric light and power installations and steam equipment. In addition to acting as dealers and manufacturers' agents for electrical and steam apparatus, the company will do general repair work and manufacture and deal in station supplies, besides handling second-hand electrical machinery. The active members of the company are W. H. Pelton, H. H. Holding and Allan Bassett.

The Mark Iron & Steel Co. has been incorporated at Plano, Ill., with a capital stock of $100,000, for manufacturing and dealing in railway equipment, by Julian R. Steward, W. D. Steward, and J. D. Morris.

The Peninsular Engineering Co., Detroit, consulting and contracting engineers and manufacturers, and dealers in iron and steel structural materials, was incorporated last week. Capital stock, $5,000; stockholders, A. A. Cowles, 150 shares; J. C. Danziger, 100 shares; F. A. Goodrich, 101 shares; Wm. Gerhauser, 49 shares, and Wm. Gerhauser, trustee, 100 shares.

A plant for the manufacture of sash weights from tin scrap is to be established at West Middlesex, Pa. The contract for machinery has been placed in Cleveland.

The Mark Iron & Steel Co., Plano, Ill., has been incorporated with capital of $100,000 to manufacture and deal in railroad equipment. Incorporators are Julian R. Stewart, W. D. Stewart and J. D. Morris.

Marysville Machine Shop & Foundry, Marysville, Wash., made its first castings Dec. 16.

The John S. Davis Sons foundry and threshing machine plant in Davenport, Ia., has been sold to a syndicate composed of Rock Island and Davenport capitalists, and will be under the management of L. J. S. Greene. The new company will engage in the manufacture of a patented automatic stock trough, a harrow disc sharpener, a mower knife grinder and other hardware and implement specialties.

Articles of association have been filed of the A. P. Wagner Tool Works Co., Detroit, with a capital of $150,000. The plant is to be located on the Michigan Central Railroad, Springwells, a suburb of Detroit. The company will have its offices and warerooms in Detroit. This plant has been in operation for some years at Sidney, O.

The Eagle Iron Co. has been incorporated by L. S. Collier, Geo. H. Webb and Jas. H. Barr, of Chattanooga, Tenn. The old Attalla, Ga., furnace property and franchises have been secured, and the new company will be capitalized at $20,000. It is expected that iron will be made early in February.

Huxley & Koehler, of Athens, Mich., are reported to be planning to erect a plant for the manufacture of steel fences.

New Construction:—

A brick and iron addition, one story, 38x58, is being built at the tin plate works of Merchant & Co., Philadelphia.

For the erection of the proposed new plant in the Birmingham district the directors of the Addyston Pipe & Steel Co., Cincinnati, voted to increase their capital stock by $300,000 of cumulative 6 per cent preferred stock. Ensley City and Bessemer have made offers of sites. Stockholders meet Jan. 19 to ratify the directors' action. The company expects to reach for export trade from its Southern plant.

It is reported that important additions will be made to the plants of the Pittsburg Reduction Co., at New Kensington, Pa., and Niagara Falls, N. Y. At the latter plant, where the aluminum is produced, the power will be increased by 4,000 h. p., making the total power of the plant about 12,000 h. p. A steel frame building, about 80 feet wide and 100 feet long, will be erected. A new rolling mill is to be built at New Kensington, also. At present the company sends its ingots to the Washburn & Moen Mfg. Co., at Worcester, Mass., and to John A. Roebling's Sons Co., at Trenton, N. J., to have

For every ten (10) degrees added to the temperature of the feed-water, about one per cent of the total cost for fuel will be saved.

210°
160°
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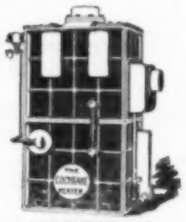
Many feed-water heaters give a lower temperature than 160°, because their heating surfaces are coated with scale and oil, or because insufficient heating surface is provided.

210 degrees is easily obtainable with a Cochrane Heater every day—every year. You can always get the temperature, due to the steam, with a "Cochrane," so long as you can get the steam and water into them. We furnish a thermometer with each one, just to show you what they are doing; and then these heaters really purify the water, no matter how bad it is, or what kind of scale is in it. Wonderfully easy to clean. Reliable in operation. Made of the best materials—best suited to withstand corrosion or the action of the acids found in feed-waters.



HARRISON
SAFETY BOILER WORKS,
Heater Department,
Philadelphia, Pa.

them rolled down. Under the new arrangement the company will do its own rolling. The rolling mill building will be 125 feet long by 60 feet wide, mainly constructed of steel. The Schultz Bridge & Iron Co. has the building contract.

The Pittsburg Bridge Co., of Pittsburg, has received an order from the Mexican Central Railway for the erection of 700 tons of structural material. It will be furnished by the Carnegie Steel Co., Ltd. The Pittsburg Bridge Co. will also furnish material for a library and assembly room for the Leland Stanford, Jr., University in California.

The Crescent Steel Co., of Pittsburg, will construct a cantilever bridge on the Allegheny River back of its works for transferring coal from barges to its plant.

The Gillette & Herzog Mfg. Co., Minneapolis, Minn., has taken the contract for three new buildings for the Midland Railway at Colorado City, Col. They are a locomotive erecting shop, a boiler shop, and a blacksmith shop, all of structural iron. A new feature is that they are to be lined with asbestos.

Work is in progress at Sacramento, Cal., on new shops for the Southern Pacific, to replace those that burned.

The Dain Mfg. Co., Chillicothe, Mo., is looking for a new location for its implement works.

A shovel works with a capacity of 200 dozen shovels a day is to be started at New Castle, Pa., by David Jamison, David C. Wallace, formerly secretary of the New Castle Tube Works, and others. The plant will be in operation the coming season.

At La Crosse, Wis., the La Crosse Plow Co. is building an addition to its works.

Fires and Accidents:—

At the works of the Merchants' Foundry & Machine Co., Fall River, Mass., fire caused a loss of $2,500, Dec. 18.

Fire at the Phoenix Iron Works Co.'s plant at Phoenixville, Pa., caused considerable loss in machinery, but was not so serious as press dispatches indicated.

At Sacramento, Cal., fire at the Union Iron Works did about $10,000 damage.

At Conshohocken, Pa., the main portion of the John Wood Mfg. Co.'s iron plant was destroyed by a fire Dec. 14. Loss, $60,000, partly insured.

General Industrial Notes:—

Powell & Colne, New York agents for the Tropenas steel process, have licensed the Milwaukee Steel Casting Co., of Milwaukee, Wis., a concern recently organized and now controlled by George H. Swith, of Pfeiffer & Smith, and late of the firm of C. J. Smith & Sons Co., of Milwaukee. The company will install one two-ton Tropenas converter, and expects to add another next year.

W. S. Rockwell & Co., the New York furnace engineers, have just erected for the Peck, Stow & Wilcox Co., Southington, Conn., two of their improved oil annealing furnaces. This is the third contract they have executed for this company.

The Greensburg Bolt & Mfg. Co., Greensburg, Pa., manufacturer of bolts and nuts, will start its plant at Greensburg, as soon as new and improved machinery has been installed. The capacity of the plant will be very much enlarged.

The Janesville Machine Co., Janesville, Wis., has contracts on hand to last through the winter, with bright prospects for future work. The following officers were elected at the recent annual meeting: President, A. P. Lovejoy; vice-president, Hiram Merrill; treasurer, John G. Rexford; secretary, S. M. Smith; superintendent, S. C. Cobb; general manager, J. A. Craig.

The Rippel foundry, at Mt. Gilead, O., was sold at sheriff's sale, Dec. 17, for $3,700. It is probable that it will be converted into a pottery.

At Greenvillle, Pa., the Kimberly rolling mill went into operation, 18 puddling furnaces and the 10-inch mill being started. The Kimberly plant at Sharon, which has been undergoing improvement will start up early in January.

The Tyrone Iron Co., Tyrone, Pa., has resumed, after enlargements and improvements.

Peter Boyd, manager of the Riverside Iron Works pipe mill at Benwood, W. Va., has perfected a bell-weld furnace, with

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Shop Saws
Cut Everything. - - - -

No. 1. Capacity, 4 inches.
No. 2. " 5 "
No. 4. " 8 "
No. 8. " 3x12 "

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For all purposes.

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UNION MINING CO,

Proprietors of the CELEBRATED Mount Savage Fire Brick

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Established 1841. Capacity, 60,000 Per Day; 18,000,000 Per Year.

The First Manufactory of its Kind in the U. S.

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"OTIS" FIRE-BOX PLATES A SPECIALTY.

Flange Plates, Ship Plates, Tank Plates, Steel Car Axles and Forgings of all kinds.

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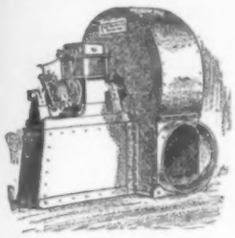

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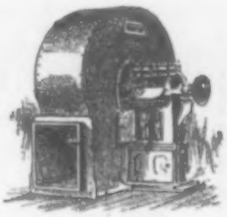

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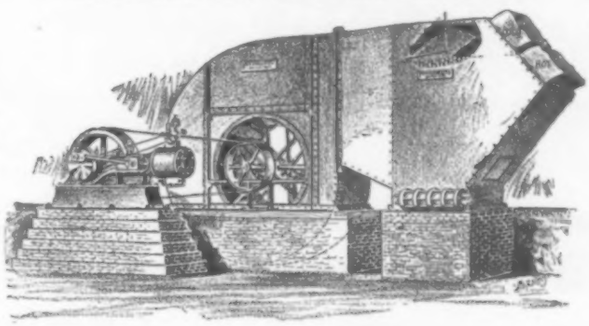

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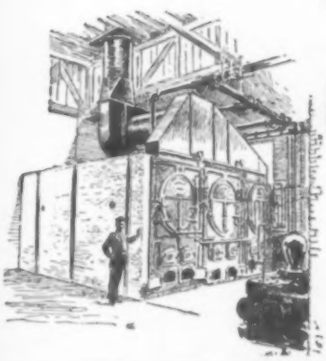

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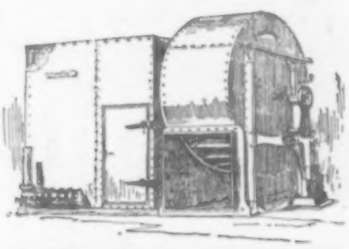

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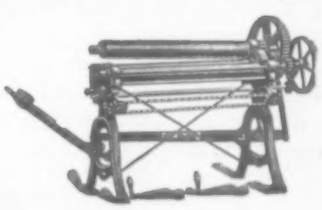

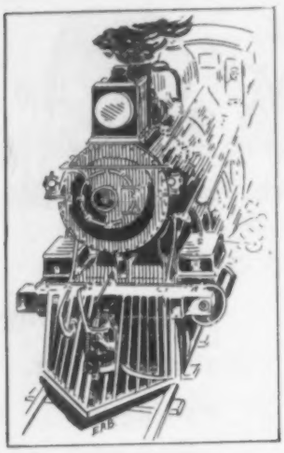

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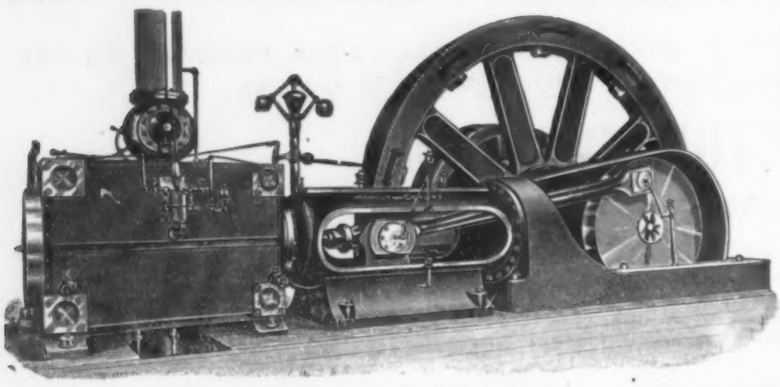

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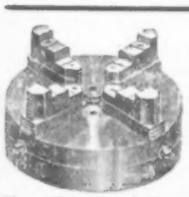

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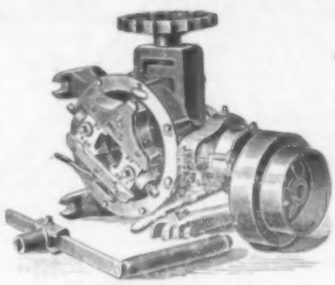

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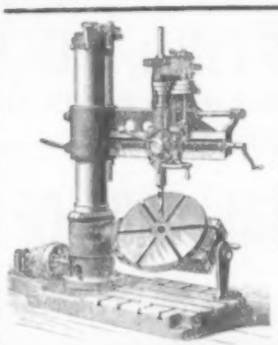

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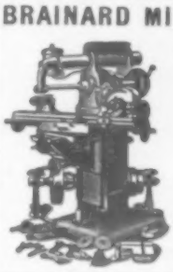

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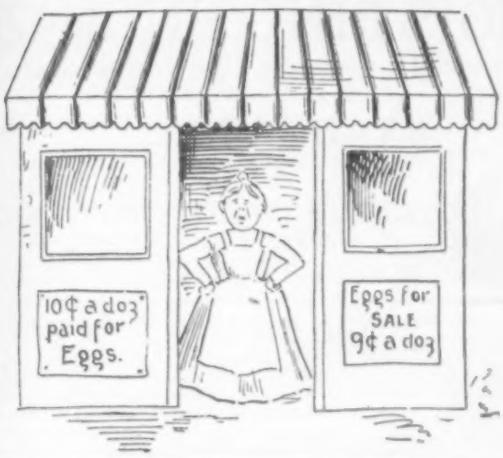

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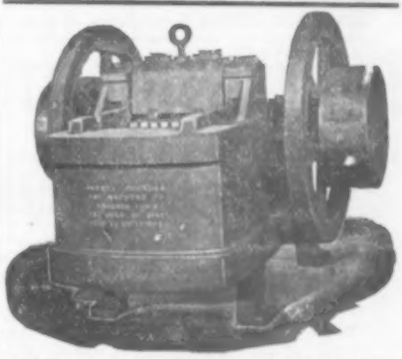

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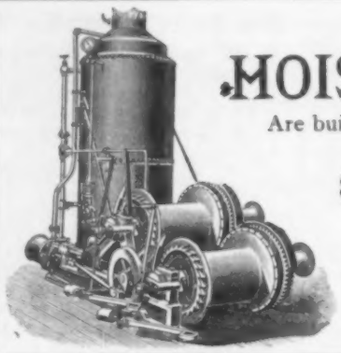

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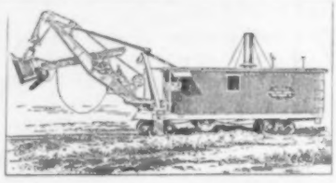

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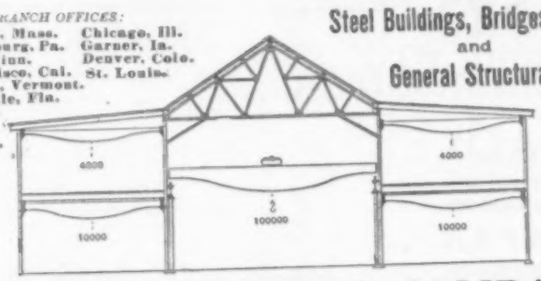

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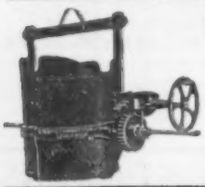

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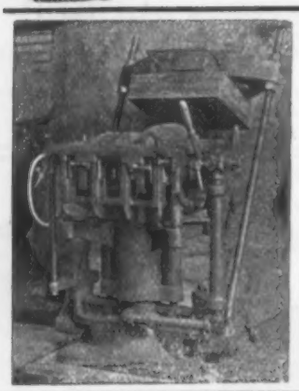

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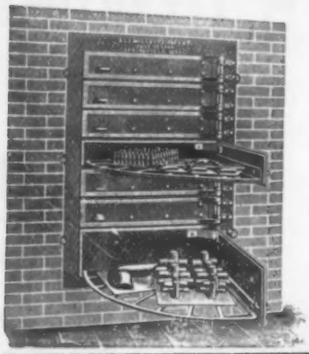

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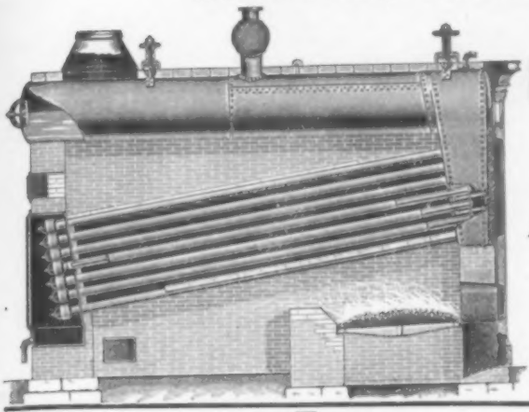

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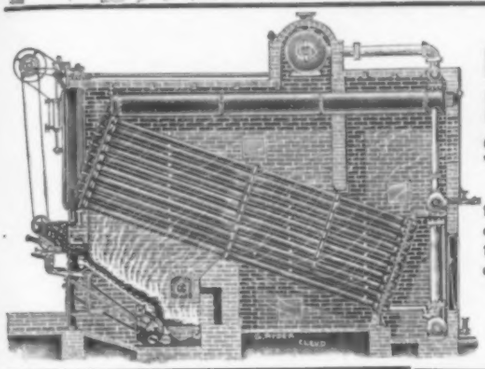

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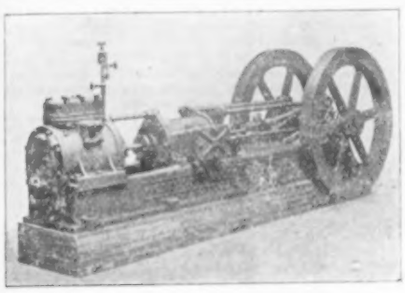

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The Aultman Co., Canton, O.

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Central Electrotype & Engraving Co., Cleveland, O.
National Engraving Co., Cleveland, O.
Eclipse Electrotype & Eng. Co., Cleveland, O.
A. Mugford, Hartford, Conn.

Exhaust Heating Apparatus—
B. F. Sturtevant Co., Boston, Mass.

Fans—
American Gas Furnace Co., New York City.
B. F. Sturtevant Co., Boston, Mass and,
W. M. Pattison Supply Co., Cleveland, O.

Feed Water Heaters and Purifiers—
Stilwell-Bierce & Smith-Vaile Co., Dayton, O.
Harrison Safety Boiler Works, Philadelphia, Pa.

Files, Makers of—
C. H. Besly & Co., Chicago, Ill.

Filters—
Burt Mfg. Co., Akron, O.

Fire Brick and Clay—
J. V. Rose, Sharon, Pa.
Union Mining Co., Mt. Savage, Md.
Reese, Hammond & Co., Bolivar, Pa.
Clearfield Fire Brick Co., Clearfield, Pa.
Dover Fire Brick Co., Cleveland.
Diamond Fire Brick Works, Akron, O.
F. B. Stevens, Detroit, Mich.
The S. Obermayer Co., Cincinnati, O.
Chicago Fire-Clay Product Co., Chicago, Ill.
Columbia Fire Clay Co., Cleveland, O.
Scioto Star Fire Brick Works, Portsmouth, O.

Fire Proof Covering—
C. H. Besly & Co., Chicago, Ill.

Fluor Spar
James Irwin & Co., Pittsburg, Pa.

Foot and Power Lathes—
U. Baird Machinery Co., Pittsburg, Pa.
Edwin Harrington Son & Co., Philadelphia, Pa.

Foundries—
Wm. Tod & Co., Youngstown, O.
Seaman, Sleeth Co., Pittsburg, Pa.
The Lane & Bodley Co., Cincinnati, O.
Hooven, Owens & Rentschler Co., Hamilton, O.
W. A. Jones Foundry Co., Chicago.
Jeffrey Mfg. Co., Columbus, O.
Geo. B. Sennett Co., Youngstown, O.
Totton & Hogg Iron and Steel Foundry Co., Pittsburg, Pa.
Brass Founders' Supply Co., Newark, N. J.
The Aultman Co., Canton, O.
W. A. Wood Mowing & Reaping Machine Co., Hoosick Falls, N. Y.

Foundry Equipments—
The S. Obermayer Co., Cincinnati, O.

Foundry Supplies—
Clearfield Fire Brick Co., Clearfield, Pa.
Stuart Fire Brick Co., Pittsburg, Pa.
The Ohio Sand Co., Conneaut, O.
Union Mining Co., Mt. Savage, Md.
Dover Fire-Brick Co., Cleveland, O.
Reese-Hammond & Co., Bolivar, Pa.
Tabor Mfg. Co., Elizabeth, N. J.
Byram & Co., Detroit, Mich.
F. B. Stevens, Detroit, Mich.
Heber Wells, New York City.
Millett Core Oven Co., Brightwood, Mass.
Reeves Bros., Alliance, O.
Hanson McDowell, Chicago, Ill.
Cleveland Facing Mill Co., Cleveland, O.
The S. Obermayer Co., Cincinnati, O.
Garden City Sand Co., Chicago, Ill.
James Irwin & Co., Pittsburg, Pa.
Chicago Fire Clay Product Co., Chicago, Ill.
Brass Founders' Supply Co., Newark, N. J.
Standard Sand Co., Everett, O.
Columbia Fire Clay Co., Cleveland, O.
Vulcan Mfg. Co., Pittsburg, Pa.
Scioto Star Fire Brick Works, Portsmouth, O.

Foundry Facings—
The S. Obermayer Co., Cincinnati, O.

Forgings—
Cleveland City Forge & Iron Co., Cleveland, O.
Bethlehem Iron Co., South Bethlehem, Pa.
Braeburn Steel Co., Braeburn, Pa.
Wyman & Gordon, Worchester, Mass.

Friction Metal—
C. H. Besly & Co., Chicago, Ill.
North American Metaline Co., Long Island City, New York.
Swarts Metal Refining Co., Chicago, Ill.

Furnaces—
Brightman Furnace Co., Cleveland, O.
Playford Stoker Co., Cleveland, O.

Furnace Linings—
Union Mining Co., Mt. Savage, Md.

Fuel Oil Burners—
W. S. Rockwell & Co., New York City.
American Gas Furnace Co., New York City.

Galvanized Iron—
Apollo Iron & Steel Co., Pittsburg, Pa.

Galvanizers—
Ætna-Standard Iron & Steel Co., Bridgeport, O.
Apollo Iron & Steel Co., Pittsburg, Pa.

Galvanizing Pots—
Wm. B. Pollock & Co., Youngstown, O.

Gas Burners—
American Gas Furnace Co., New York City.

Gas Furnaces—
American Gas Furnace Co., New York City.

Gear Cutting—
The R. D. Nuttall Co., Allegheny, Pa.
Brainard Milling Machine Co., Hyde Park, Mass.

Gear Cutters—
Brainard Milling Machine Co., Hyde Park, Mass.

Grindstones—
C. H. Besly & Co., Chicago, Ill.

Graphite Paint—
Jos. Dixon Crucible Co., Jersey City N. J.

Gray Iron Castings—
W. A. Jones Foundry Co., Chicago, Ill.
The Lane & Bodley Co., Cincinnati, O.
Brass Founders' Supply Co., Newark, N. J.

Hack Saws—
Millers Falls Co., New York City.
Q & C Co., Chicago, Ill.

Hangers—
E. A. Delano, Chicago, Ill.
Rice Machinery Co., Chicago, Ill.
The Aultman Co., Canton, O.

Harness Snaps—
Covert Mfg. Co., West Troy, N. Y.

Hoists—
Edwin Harrington Son & Co., Philadelphia.
Reading Crane & Hoist Works, Reading, Pa.
The Lane & Bodley Co., Cincinnati, O.
Burr Mfg. Co., Cleveland, O.

Heaters and Purifiers—
Harrison Safety Boiler Works, Philadelphia.
Stilwell-Bierce & Smith-Vaile Co., Dayton, O.

Heating and Ventilating Apparatus
B. F. Sturtevant Co., Boston.

Heavy Hardware—
C. H. Besly & Co., Chicago, Ill.
Parkhurst & Wilkinson Co., Chicago, Ill.

Hoisting Engines—
The Edward P. Allis Co., Milwaukee, Wis.
Earle C. Bacon, New York City.
The Lane & Bodley Co., Cincinnati, O.
Lidgerwood Mfg. Co., New York City.
The Aultman Co., Canton, O.

Hoisting Machinery—
Link-Belt Machinery Co., Chicago, Ill.
Reading Crane & Hoist Works, Reading, Pa.
Jeffrey Mfg. Co., Columbus, O.
The Lane & Bodley Co., Cincinnati, O.
Case Mfg. Co., Columbus, O.
Earl C. Bacon, New York City.
Lidgerwood Mfg. Co., New York City.
Burr Mfg. Co., Cleveland, O.
Heyl & Patterson, Pittsburg, Pa.
The Aultman Co., Canton, O.

Horse Shoes—
Phoenix Horse Shoe Co., Joliett, Ill.

Hotels—
United States Hotel Co., Cleveland, O.

Hydraulic Machinery—
Stilwell-Bierce & Smith-Vaile Co., Dayton, O.

Injectors—
C. H. Besly & Co., Chicago, Ill.

Insurance Companies—
Hartford Steam Boiler I. & I. Co., Hartford, Ct.

Iron Buildings—
Shiffler Bridge Co., Pittsburg, Pa.
Berlin Iron Bridge Co., East Berlin, Conn.
Pittsburg Bridge Co., Pittsburg, Pa.
Riter-Conely Co., Pittsburg, Pa.

Iron Nails and Steel—
Bethlehem Iron Co., South Bethlehem, Pa.
C. H. Besly & Co., Chicago, Ill.
E. H. Stroud & Co., Chicago, Ill.
Parkhurst & Wilkinson Co., Chicago, Ill.

Iron and Steel Roofing—
Berger Mfg. Co., Canton, O.
Ætna-Standard Iron & Steel Co., Bridgeport, O.

Iron Ore—
Lake Superior Consolidated Iron Mines New York City, N. Y.
Ogiebay, Norton & Co., Cleveland, O.
M. A. Hanna & Co., Cleveland, O.

Iron Working Tools—
H. Bickford, Lakeport, N. H.
C. H. Besly & Co., Chicago, Ill.
John Adt & Son, New Haven, Conn.
U. Baird Machinery Co., Pittsburg, Pa.
Edwin Harrington Son & Co., Philadelphia, Pa.
Fox Machine Co., Grand Rapids, Mich.
Armstrong Bros. Tool Co., Chicago, Ill.
The Armstrong Mfg. Co., Bridgeport, Conn.
Chicago Die and Machine Works, Chicago, Ill.
Bickford Drill & Tool Co., Cincinnati, O.
Skinner Chuck Co., New Britain, Conn.
Cleveland Tool & Supply Co., Cleveland, O.
Brainard Milling Machine Co., Hyde Park, Mass.
W. M. Pattison Supply Co., Cleveland, O.
Baush & Harris Machine Tool Co., Springfield, Mass.

Link Belting—
The Jeffrey Mfg. Co., Columbus, O.
Link-Belt Machinery Co., Chicago, Ill.
Heyl & Patterson, Pittsburg, Pa.
The Aultman Co., Canton, O.

Ladles—
Byram & Co., Detroit, Mich.
The S. Obermayer Co., Cincinnati, O.

Lathes—
U. Baird Machinery Co., Pittsburg, Pa.
Edwin Harrington, Son & Co., Philadelphia.
Bickford Drill & Tool Co., Cincinnati, O.

Machinery Name Plates—
August Becker, Boston, Mass.

Machinists' Tools and Supplies—
H. Bickford, Lakeport, N. H.
C. H. Besly & Co., Chicago, Ill.
U. Baird Machinery Co., Pittsburg, Pa.
Bertsch & Co., Cambridge City, Ind.
Edwin Harrington Son & Co., Philadelphia, Pa.
Fox Machine Co., Grand Rapids, Mich.
Armstrong Bros. Tool Co., Chicago, Ill.
Bickford Drill & Tool Co., Cincinnati, O.
Parkhurst & Wilkinson Co., Chicago, Ill.
Hill, Clarke & Co., Chicago, Ill.
Skinner Chuck Co., New Britain, Conn.
Cleveland Tool & Supply Co., Cleveland, O.
W. M. Pattison Supply Co., Cleveland, O.
Baush & Harris Machine Tool Co., Springfield, Mass.

Machine Screws—
C. H. Besly & Co., Chicago, Ill.

Machine Shops—
The R. D. Nuttall Co., Allegheny, Pa.
The Lane & Bodley Co., Cincinnati, O.

Machinery and Tool Steel—
W. M. Pattison Supply Co., Cleveland, O.
C. H. Besley & Co., Chicago, Ill.
Braeburn Steel Co., Braeburn, Pa.
Crescent Steel Co., Pittsburg, Pa.
La Belle Steel Co., Pittsburg, Pa

Magnesia Covering—
C. H. Besly & Co., Chicago, Ill.

Malleable Iron Castings—
W. A. Wood Mowing & Reaping Machine Co., Hoosick Falls, N. Y.

Manufacturing Chemists—
James Irwin & Co., Pittsburg, Pa.

Manufactured Iron & Steel—
Bourne-Fuller & Co., Cleveland, O.
Cleveland Rolling Mill Co., Cleveland, O.
Ætna-Standard Iron & Steel Co Bridgeport, O.
The Morris & Bailey Steel Co., Pittsburg, Pa.
Parkhurst & Wilkinson Co., Chicago, Ill.
Ohio Steel Co., Youngstown, O.

Metal Bearings—
North American Metaline Co., Long Island City, N. Y.
C. H. Besly & Co., Chicago, Ill.

Milling Machines—
U. Baird Machinery Co., Pittsburg, Pa.
Fox Machine Co., Grand Rapids, Mich.
Brainard Milling Machine Co., Hyde Park, Mass.

Mining Machinery—
C. H. Besly & Co., Chicago, Ill.
The Edward P. Allis Co., Milwaukee, Wis.
Earle C. Bacon, New York City.
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W. M. Pattison Supply Co., Cleveland, O.
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Lidgerwood Mfg. Co., New York City.
Wm. Cramp & Sons, Philadelphia, Pa.
The Bucyrus Co., South Milwaukee, Wis.

Motors—
Storey Motor & Tool Co., Trenton, N. J.

Molding Machines—
Tabor Mfg. Co., Elizabeth, N. J.

Molding Sand—
Ohio Sand Co., Conneaut, O.
F. B. Stevens, Detroit, Mich.
S. Obermayer Co., Cincinnati, O.
Garden City Sand Co., Chicago, Ill.
Standard Sand Co., Everett, O.

Molders' Tools—
The S. Obermayer Co., Cincinnati, O.

Name Plates—
August Becker, Boston, Mass.

Nickel Plating Outfits—
The Hanson & Van Winkle Co., Newark, Chicago, New York.
Northampton Emery Wheel Co., Chicago, Ill.
Bennett & O'Connell Co., Chicago, Ill.

Nuts and Bolts
Rockford Bolt Works, Rockford, Ill.
Upson Nut Co., Cleveland, O.
W. M. Pattison Supply Co., Cleveland, O.

Oilless Bearings—
North American Metaline Co., Long Island, City, N. Y.
C. H. Besly & Co., Chicago, Ill.

Oil Burners—
W. S. Rockwell & Co., New York City.
American Gas Furnace Co., New York City.

Oil Cups—
C. H. Besly & Co., Chicago, Ill.

Oil Filters—
Burt Mfg. Co., Akron, O.

Oil Pumps—
C. H. Besly & Co., Chicago, Ill.

Ore Crushers—
The Edward P. Allis Co., Milwaukee, Wis.
Jeffrey Mfg. Co., Columbus, O.
The Aultman Co., Canton, O.

Ore Screens—
Rob't Aitchison Per. Metal Co., Chicago, Ill.
Harrington & King Per. Co., Chicago, Ill.
A. J. Beckley & Co., Garwood, N. J.
The Aultman Co., Canton, O.

Packing—
C. H. Besly & Co., Chicago Ill
Jenkins Bros., New York City

Paint—
Iron Clad Paint Co., Cleveland, O.
Jos. Dixon Crucible Co., Jersey City, N. J.
Standard Paint Co., New York, City.

Pattern Letters—
Heber Wells, New York City.

Pattern Works—
Gobeille Pattern Co., Cleveland O

Perforated Sheet Metal—
Harrington & King Perforating Co., Chicago, Ill
Aitchison Perforated Metal Co., Chicago, Ill.
A. J. Beckley & Co., Garwood N. J.

Pig Iron—
Clinton Iron & Steel Co., Pittsburg.
Forster, Waterbury & Co., Chicago, Ill.
W. M. Pattison Supply Co., Cleveland, O.
Bourne-Fuller Co. Cleveland, O.
M. A. Hanna & Co., Cleveland, O.
E. H. Stroud & Co., Chicago, Ill.
F. B. Stevens, Detroit, Mich.
McKeefrey & Co., Leetonia, O.
Superior Charcoal Iron Co., Grand Rapids, Mich
Hickman & Williams, Chicago, Ill.
Shenango Valley Steel Co., New Castle, Pa.
Spearman Iron Co., Sharpsville, Pa.

Pipe Covering—
C. H. Besly & Co., Chicago, Ill.
Jenkins Bros., New York City.

Pipe
W. M. Pattison Supply Co., Cleveland, O.

Pipe Cutting and Threading Machines—
The Armstrong Mfg. Co., Bridgeport, Conn.

Planers—
U. Baird Machinery Co., Pittsburg, Pa.
Bickford Drill & Tool Co., Cincinnati, O.

Plates—
Enterprise Boiler Co., Youngstown, O.
Reeves Bros., Alliance, O.

Plumbago—
The S. Obermayer Co., Cincinnati, O.

Plumbers' and Gas Fitters' Supplies—
C. H. Besly & Co., Chicago, Ill.

Pneumatic Appliances—
Clayton Air Compressor Works, New York.

Portable Forge—
C. H. Besly & Co., Chicago, Ill.
B. F. Sturtevant Co., Boston, Mass.
Vulcan Mfg. Co., Pittsburg, Pa.

Power Drop Hammers—
Baush & Harris Machine Tool Co., Springfield Mass.

Power Presses—
Bertsch & Co., Cambridge City, Ind.
Fox Machine Co., Grand Rapids, Mich.
The Long & Allstatter Co., Hamilton, O.
Ferracute Machine Co., Bridgeton, N. J.

Power Transmission Machinery—
Jeffrey Mfg. Co., Columbus, O.
The Lane & Bodley Co., Cincinnati, O
E. A. Delano, Chicago, Ill.
Rice Machinery Co., Chicago, Ill.
The Aultman Co., Canton, O.

Presses—
Bertsch & Co., Cambridge City, Ind.
C. H. Besly & Co., Chicago, Ill.
The Long & Allstatter Co., Hamilton, O.
Ferracute Machine Co., Bridgeton, N. J.

Pressure Gauges—
The Bristol Co., Waterbury, Conn.

Pressure Reducing Valves—
W. M. Pattison Supply Co., Cleveland, O.

Pulleys—
W. A. Jones Foundry Co., Chicago, Ill.
The Lane & Bodley Co., Cincinnati, O.
E. A. Delano, Chicago, Ill.
Rice Machinery Co., Chicago, Ill.
The Aultman Co., Canton, O.
Jeffrey Mfg. Co., Columbus, O.

Pumps (Steam)—
The Edward P. Allis Co., Milwaukee, Wis.
Stilwell-Bierce & Smith-Vaile Co., Dayton, O
W. M. Pattison Supply Co., Cleveland, O.
Blakeslee Mfg. Co., Du Quoin, Ill,

Punches—
The Long & Allstatter Co., Hamilton, O.
Pyrometers—
Edward Brown, Philadelphia, Pa.
Uehling, Steinbart & Co., Newark, N. J.
Vulcan Mfg. Co., Pittsburg, Pa.
Railway Supplies—
Cleveland City Forge & Iron Co., Cleveland, O.
Rivets—
Champion Rivet Co., Cleveland, O.
Riveted Steel Pipe—
Wm. B. Pollock & Co. Youngstown, O.
Rock Drills—
Rand Drill Co., Chicago, Ill.
The Ingersoll-Sergeant Drill Co., New York.
Rolling Mill Machinery—
Totten & Hogg Iron and Steel Foundry Co., Pittsburg, Pa.
Rarig Engineering Co., Columbus, O.
Roofs—
Shiffler Bridge Co., Pittsburg.
Berlin Iron Bridge Co., East Berlin, Conn.
Pittsburg Bridge Co., Pittsburg, Pa.
Riter-Conley Mfg. Co., Pittsburg, Pa.
Safety Lift Blocks—
Burr Mfg. Co., Cleveland, O.
Sand—
David Tod Sand Co., Youngstown, O.
Sand and Gravel Conveyors—
Seaman, Sleeth Co., Pittsburg, Pa.
Totten & Hogg Iron and Steel Foundry Co., Pittsburg, Pa.
Saws—
Peter Gerlach & Co., Cleveland, O.
Screens for Coal, Ore, &c.
Robt. Aitchison Perforated Metal Co., Chicago.
Harrington & King Perforating Co., Chicago.
Jeffrey Mfg. Co., Columbus, O.
A. J. Beckley & Co., Garwood, N. J.
The Aultman Co., Canton, O.
Screws—
C. H. Besly & Co., Chicago, Ill.
Upson Nut Co., Cleveland, O.
Chicago Screw Co., Chicago, Ill
Rockford Bolt Works, Rockford, Ill.
Shafting—
The Lane & Bodley Co., Cincinnati, O.
E. A. Delano, Chicago, Ill.
Fitzsimmons & Co., Cleveland, O.
Rice Machinery Co., Chicago, Ill.
The Aultman Co., Canton, O.
Jeffrey Mfg. Co., Columbus, O.
Shapes—
Baush & Harris Machine Tool Co., Springfield, Mass.
Shearing and Punching Machinery—
Bertsch & Co., Cambridge City, Ind.
Fox Machine Co., Grand Rapids, Mich.
The Long & Allstatter Co., Hamilton, O.
Sheet Iron—
Cleveland Rolling Mill Co., Cleveland, O.
Ætna-Standard Iron & Steel Co., Bridgeport, O.
E. H. Stroud & Co., Chicago, Ill.
Ship Yards—
Wm. Cramp & Sons, Philadelphia, Pa.
Special Machinery—
Edwin Harrington Son & Co., Philadelphia.
Q & C Co., Chicago, Ill.
A. H. Nilson Machine Co., Bridgeport, Conn.
The Aultman Co., Canton, O.
Jeffrey Mfg. Co., Columbus, O.
Stand Pipes—
Wm. B. Pollock & Co., Youngstown, O.
Steam Boiler Inspectors—
Hartford Steam Boiler Inspection & Insurance Co., Hartford, Conn.
Steam Pipe and Boiler Covering—
C. H. Besly & Co., Chicago Ill.
Steam Packing—
C. H. Besly & Co., Chicago, Ill.
Steam Pumps—
Hall Steam Pump Co., Pittsburg, Pa.
Steam Shovels and Dredges—
Marion Steam Shovel Co., Marion, O.
The Bucyrus Co., South Milwaukee, Wis.
Steam Specialties—
C. H. Besly & Co., Chicago, Ill.
Steel—
Otis Steel Co., Cleveland, O.
Miller, Wagoner, Fieser & Co., Chicago, Ill.
E. H. Stroud & Co., Chicago, Ill.
Bræburn Steel Co., Bræburn, Pa.
Crescent Steel Co., Pittsburg, Pa.
La Belle Steel Co., Pittsburg, Pa.
The Morris & Bailey Steel Co., Pittsburg, Pa.
Sanderson Bros. Steel Co., Cleveland, O.
Steel Castings—
W. M. Pattison Supply Co., Cleveland, O.
Otis Steel Co., Cleveland, O.
Q & C Co., Chicago, Ill.
Hanson McDowell, Chicago, Ill.
Totten & Hogg Iron and Steel Foundry Co., Pittsburg, Pa.
Steel Plants—
Wm. B. Pollock & Co., Youngstown, O.
The Riter-Conley Co., Pittsburg, Pa.
Steel Blooms and Billets—
Cleveland Rolling Mill Co., Cleveland.
Bethlehem Iron Co., South Bethlehem, Pa.
Ohio Steel Co., Youngstown, Ohio.
Shenango Valley Steel Co., New Castle, Pa.
Steel Stamps and Stencils—
J. H. Fleharty & Co., Cleveland, O.
Semi-Steel—
Hanson McDowell, Chicago, Ill.
Stokers—
Playford Stoker Co., Cleveland, O.
Brightman Furnace Co., Cleveland, O.
Tackle Blocks—
Burr Mfg. Co, Cleveland, O.
Tanks—
Pittsburg Boiler Co., Youngstown, O.
Meehan Boiler & Construction Co., Lowellville Ohio
Williams Mfg. Co., Kalamazoo, Mich.
Wm. B. Pollock & Co., Youngstown, O.
Reeves Bros., Alliance, O.
Rarig Engineering Co., Columbus, O.
Riter-Conley Mfg. Co., Pittsburg, Pa.
The Aultman Co., Canton, O.

Tank Cars—
Wm. B. Pollock & Co., Youngstown, O.
Tinning Machinery—
W. M. Pattison Supply Co., Cleveland, O.
Totten & Hogg Iron & Steel Fdy. Co., Pittsburg, Pa.
Tin Plate—
Ætna-Standard Iron & Steel Co., Bridgeport, O.
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Tin and Terne Plates—
B. P. Crane & Co., Chicago, Ill.
E. H. Stroud & Co., Chicago, Ill.
Tool Steel—
C. H. Besly & Co., Chicago, Ill.
Bræburn Steel Co., Bræburn, Pa.
Crescent Steel Co., Pittsburg, Pa.
La Belle Steel Co., Pittsburg, Pa.
Sanderson Bros. Steel Co., Cleveland, O.
Transmission Machinery—
Heyl & Patterson, Pittsburg, Pa.
Link-Belt Machinery Co., Chicago, Ill.
The Lane & Bodley Co., Cincinnati, O.
W. A. Jones Foundry & Machine Co., Chicago, Ill
Jeffrey Mfg. Co., Columbus, O.
Rice Machinery Co., Chicago, Ill.
The Aultman Co., Canton, O.
Tubes—
National Tube Works, McKeesport, Pa.
Tube Welding
S. Pix Sons, Cleveland, O.
Tubing (brass)—
Wm. S. Spofford & Son, Providence, R. I.
Tumbling Mills—
The S. Obermayer Co., Cincinnati, O.
Turnbuckles—
Cleveland City Forge & Iron Co., Cleveland, O.
W. M. Pattison Supply Co., Cleveland, O.
Twist Drills—
C. H. Besly & Co., Chicago, Ill.
Twist Drill Cases—
Vulcan Mfg. Co., Pittsburg, Pa.
Valves—
C. H. Besly & Co., Chicago, Ill.
Jenkins Bros., New York City.
Ventilating Fans—
B. F. Sturtevant Co., Boston Mass
Wire Machinery—
John Adt & Son, New Haven, Conn.
S. W. Goodyear, Waterbury, Conn.
A. H. Nilson Machine Co., Bridgeport, Conn.
Wire Nails—
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Upson Nut Co	1
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FINE TOOL STEEL AND FORGINGS. ALSO SPRING HAMMER, AND MACHINERY STEEL OF HIGH QUALITY. FINE OPEN-HEARTH STEEL.

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EASY TO GET..... Our stock is so large and well assorted that all ordinary orders are filled the same day they are received.
EASY TO WORK..... Our annealed steel has never been equalled.
EASY TO TEMPER... This steel is not over sensitive and will stand any ordinary handling without cracking when you come to harden the finished tool.
EASY TO PAY FOR... When its good qualities are so apparent.
It pays to use "the most reliable tool steel in the market."
SANDERSON BROTHERS STEEL CO., Cleveland Warehouse: 97 Water St., CLEVELAND, O.

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IRON ORE.
[On Lake Erie docks.]

Special low-phosphorus hard Ore, Bessemer	3.65
No. 1 Specular, Bessemer	3.01@ 3.35
No. 1 Bessemer hematite	2.75@ 3.15
Hematites No. 1 non-Bessemer	2.00@ 2.20
No 1. Specular, non-Bessemer	2.40@ 2.50
Mesabi Bessemer	2.20@ 2.35

PIG IRON.

CLEVELAND (f. o. b. cars):	
Bessemer	$ 10 65
No. 1 Strong Foundry	10 40@10 65
No. 2 Strong Foundry	10 15@10 25
Gray Forge, red short	..... 9 50
Gray Forge, neutral	9 25
No. 1 American Scotch	..... 10 65
No. 2 American Scotch	10 15@10 40
Lake Superior Charcoal	..... 11 5
PITTSBURG:	
No. 1 Foundry	$10 50@ 10 65
No. 2 Foundry	10 00@ 10 25
Gray Forge	9 25@ 9 35
White and Mottled	..... 9 00
Warm Blast Charcoal	13 00@ 13 50
Cold Blast Charcoal	22 00@ 26 00
Bessemer	10 35@ 10 50
CHICAGO:	
Lake Superior Charcoal	$11 50@$13 00
Local Coke Foundry No. 1	11 50@ 12 00
Local Coke Foundry No. 2	11 00@ 11 50
Local Coke Foundry No. 3	10 75@ 11 00
Local Scotch Foundry No. 1	11 50@ 12 00
Local Scotch Foundry No. 2	11 00@ 11 50
Local Scotch Foundry No. 3	10 75@ 11 00
Southern Coke No. 1	..... @ 10 85
Southern Coke No. 2	..... @ 10 60
Southern Coke No. 3	..... @ 10 10
Southern No. 1 Soft	..... @ 10 80
Southern No. 2 Soft	..... @ 10 65
Southern Silveries	11 25@ 11 50
Jackson Co. Silveries	12 50@ 14 50
Ohio Silveries No. 1	..... @ .....
Ohio Strong Softeners	12 00@ 12 50
Alabama Car Wheel	15 00@ 16 00
Malleable Bessemer	11 50@ 12 00
Coke Bessemer	11 50@ 12 00
CINCINNATI (reported by Rogers, Brown & Co.)	
Southern Coke No. 1, Foundry	$10 00@ 10 25
Southern Coke No. 2 and No. 1 Soft	9 75@ 10 00
Hanging Rock Coke, No 1	..... 9 45
Hanging Rock Charcoal No. 1, Fdy	14 50@ 15 50
Tennessee Charcoal No 1	12 50@ 13 00
Jackson County Silvery No 1	12 00@ 12 50
Southern Coke, Gray Forge	8 75@ 9 00
" Mottled	8 75@ 9 00
Standard Georgia Car Wheel	14 25@ 15 00
Tennessee " "	13 00@ 14 00
Lake Superior " "	14 25@ 14 50
BUFFALO:	
No. 1 Foundry Strong Coke Iron Lake Superior Ore	11 00@ 11 25
No. 2 Foundry Strong Coke Iron Lake Superior Ore	10 50@ 10 75
Ohio Strong Softener No. 1	11 50@ 11 75
Jackson Co. Silvery No. 1	..... 14 00
Lake Superior Charcoal	..... 11 50
Southern Soft No. 1	10 50@ 11 7
Hanging Rock Charcoal	..... 1 0
ST. LOUIS:	
Southern Coke No 1	$ $10 50
Southern Coke No. 2	..... 10 25
Southern Coke No. 3	..... 9 75
Southern Gray Forge	..... 9 25
Southern Charcoal No. 1	..... 10 50
Missouri Bessemer	..... 13 00
Lake Superior Car Wheel	..... 13 00
Ohio Softeners	..... 14 00
Southern Car Wheel	..... 15 00

OLD RAILS AND SCRAP METAL.

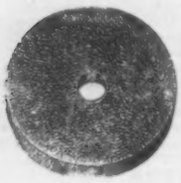
[Delivered Cleveland.]	Gross Tons
Old iron rails	$13 50
Old steel rails (6 ft. and over)	9 75
Old steel rails (6 ft. and under)	9 75
Old car wheels	11 00
	Net Tons
No. 1 R. R. wrought scrap	$11 00
Mill scrap	8 00
No. 1 Machine cast scrap	8 25
Iron axles	15 50
Axle turnings	8 00
Wrought turnings (free from cast)	6 50
Cast borings	5 25
Uncut wrought iron boilers	4 00
Steel boiler plates	8 00
Grate bars	5 25
Pipes and flues (clean)	7 50
Tank iron	8 00
Hoop and band iron	7 50
Sheet iron	5 25
Wrought drillings	6 00
Malleable iron	8 50

STRUCTURAL MATERIAL.

Beams and Channels (f. o. b. Cleveland)	1.25c
Angles	1.15c
Tees	1.25c
Universal Plates	1.15@1.20c
Sheared Plates	1.20c

MERCHANT IRON AND STEEL.
[Less than car-lots, Cleveland.]
Rounds and Squares.—Bar Iron.

1 to 1⅝	1.05 Base
2 to 2⅝	.20 extra
3 to 3½	.50 "
3⅝ to 4	.80 "
4⅛ to 4⅝	1.00 "
4⅝ to 5	1.30 "
5¼ to 6	1.80
6¼ to 6⅝	2.2



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Eddy Dynamo Electro-Plating Machines

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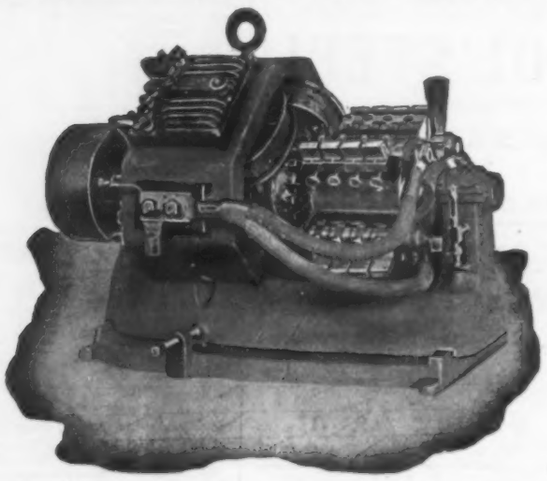

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EXCLUSIVE WESTERN SELLING AGENTS.

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REACHING with its 7,900 miles of road the famous Water Powers, Coal Fields, Iron Ore Ranges, Hard and and Soft Lumber Districts located in Illinois, Wisconsin, Michigan, Iowa, Minnesota, South Dakota, North Dakota, Nebraska and Wyoming, and by traffic arrangements with other railways, 7,350 stations located on 41,000 miles of railroad (one-ninth of the entire railroad mileage of the world, and one-fourth of the railroad mileage of the United States), has on its line more industries than any other western railroad.

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General Freight Agent,
CHICAGO.

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6⅝ to 7¾	2.50 extra
¾ to ⅞	.10 "
⅞ to 11-16	.20 "
⅝ to 9-16	.30 "
7-16 to 15-32	.40 "
⅜ to 13-72	.50 "
5-16 to 1-32	.70 "
¼ to 9-32	.90 "
7-32	1.40 "
3-16	2.50 "

Flats.—Bar Iron.

1½ to 4 x ⅜ to 1	1.05 Base
4¼ o 6 x ⅜ to 1	.10 extra
6¼ o 8 x ⅜ to 1	.60 "
8¼ o 10 x ⅜ to 1	.80 "
1⅜ o 4 x 1 1-16 to 1½	.30 "
4¼ to 6 x 1 1-16 to 1⅜	.40 "
6¼ to 8 x 1 1-16 to 1⅜	.60 "
8¼ to 10 x 1 1-16 to 1¾	.90 "
2 to 4 x 1⅜ to 2	.50 "
4¼ to 6 x 1⅜ to 2	.60 "
6¼ to 8 x 1⅜ to 2	.80 "
8¼ to 10 x 1⅜ to 2	1.00 "
2 to 4 x 2⅜ to 3	.60 "
4¼ to 6 x 2⅜ to 3	.80 "
6¼ to 8 x 2⅜ to 3	1.00 "
1⅜ to 1¾ x ⅜ to 1	.10 "
1 to 1 1-16 x ⅜ to ⅞	.20 "
¾ to 15-16 x ⅜ to ¾	.40 "
⅝ to 11-16 x ⅜ to ⅝	.50 "
½ to 9-16 x ⅜ to ½	.90 "

Heavy Band Iron.

7 to 10 x ¼ to 5-16	.70 extra.
6¼ to 6¾ x ¼ to 5-16	.50 "
4¼ to 6 x ¼ to 5-16	.30 "
1⅜ to 4 x ¼ to 5-16	.20 "
1 to 1⅜ x ¼ to 5-16	.30 "
¾ to 15-16 x ¼ to 5-16	.50 "
⅝ to 11-16 x ¼ to 5-16	.80 "
½ to 9-16 x ¼ to 5-16	1.00 "
⅜ to 7-16 x ¼ to 5-16	1.50 "

Heavy bands, 7-32 in. thick 1-10 c. per lb. higher than ¼ to 5-16 thick. **Bevel Edge Shaft Iron** 1-10 higher than same size of Heavy Bands.

Light Band Iron.

7 to 8 x No. 9 to 3-16	.90 extr
7 to 8 x Nos. 10, 11 and 12	1.00 "
6¼ to 6¾ x No. 9 to 3-16	.70 "
6¼ to 6¾ x Nos. 10, 11 and 12	.80 "
4¼ to 6 x No. 9 to 3-16	.50 "
4¼ to 6 x Nos. 10, 11 and 12	.60 "
1¼ to 4 x No. 9 to 3-16	.40 "
1¼ to 4 x Nos. 10, 11 and 12	.50 "
1 to 1 3-16 x No. 9 to 3-16	.50 "
1 to 1 3-16 x Nos. 10, 11 and 12	.60 "
13-16 to ⅞ x No. 9 to 3-16	.60 "
13-16 to ⅞ x Nos. 10, 11 and 12	.70 "
11-16 to ¾ x No. 9 to 3-16	.80 "
11-16 to ¾ x Nos. 10, 11 and 12	.90 "
9-16 to ¾ x No. 9 to 3-16	1.00 "
9-16 to ¾ x Nos. 10, 11 and 12	1.10 "
7-16 to ½ x No. 9 to 3-16	1.30 "
7-16 to ½ x Nos. 10, 11 and 12	1.40
⅜ x No. 9 to 3-16	1.50
⅜ x Nos. 10, 11 and 12	1.60

Bevel Edge Box Iron.

Same as Light Bands, of same sizes.

Beaded Band Iron, 1¼ in. to 2 in.

Sand Band Iron, 1-10 c. above same sizes o Light Bands.

Oval Iron.

⅞ to 1⅛	.40 extra.
¾ to 13-16	.50 "
⅝ to 11-16	.60 "
½ to 9-16	.80 "
⅜ to 7-16	1.10 "
½ to 9-16 x 3-16	1.00 "
⅝ to 11-16 x ⅜	1.20 "

Half Oval and Half Round.

2¾ to 3	.60 extra
⅞ to 2	.50 "
¾ to 13-16	.70 "
⅝ to 11-16	.90 "
½ to 9-16	1.20 "
⅜ to 7-16	2.50 "
5-16	3.50 "
¼	4.50 "

Half Ovals less than ¼ their width in thickness, extra price.

Horse Shoe Iron.

All sizes 1 c. extra.

Cutting ordinary bars to specified length, .20 to .30 extra, according to length and size.

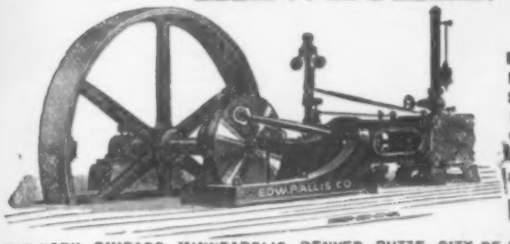
Steel Bands.

Width In Inches.	English Standard Gauge.	
1 1-2 to 6,	Nos. 7, 8, 9 or 3-16 "	1.50 Base.
		Extras.
1¼ to 6,	" 10, 11, 12 or 1/16"	.05 per 100 lbs.
1 to 1⅜,	" 7, 8, 9 or 3-16"	.10 "
1 to 1⅜,	" 10, 11, 12 or 1/16"	.15 "
13-16 and ⅞,	" 7, 8, 9 or 3-16"	.20 "
13-16 and ⅞,	" 10, 11, 12 or 1/16"	.25 "
11-16 and ¾,	" 7, 8, 9 or 3-16"	.30 "
11-16 and ¾,	" 10, 11, 12 or 1/16"	.35 "
9-16 and ⅝,	" 7, 8, 9 or 3-16"	.40 "
9-16 and ⅝,	" 10, 11, 12 or 1/16"	.45 "
½,	Nos. 7, 8, 9 or 3-16"	.55 "
½,	" 10, 11, 12 or 1/16"	.60 "
7-16	" 7, 8, 9 or 3-16"	.75 "
7-19	" 10, 11, 12 or 1/16"	.85 "
⅜,	" 7, 8, 9 or 3-16"	.95 "
⅜,	" 10, 11, 12 or 1/16"	1.05 "

Iron and Steel Hoops.

Width Inches.	English Standard Gauge.	
7-16 to 3	Nos. 13, 14, 15 and 16	1.60 Base
		Extras.
7-16 to 2,	" 17, 18, and 19	.05 per 100 lb
7-16 to 2,	" 20	.10 "
7-16 to 2,	" 21	.15 "
7-16 to 1¾,	" 22	.25 "
⅛ to 1¾,	" 13, 14 and 15	.05 "
⅛ to 1¾,	" 16, 17 and 18	.10 "

THE EDWARD P. ALLIS COMPANY
MILWAUKEE, WIS.



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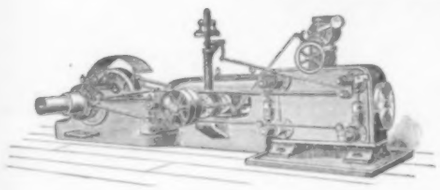

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ALL SIZES.

Simple and Compound.

Shafting, Hangers, Pulleys.

Belt Elevators, Saw Mills.

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MANUFACTURERS OF

Sennett Compression Coupling

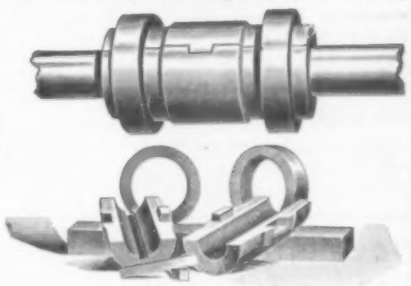
And Other Specialties.

We do not claim novelty in these Couplings so much as good material, good workmanship and extreme simplicity. We make them of a very strong cast iron, with wrought iron bands.
We make also the

SENNETT ENGINE

20 to 40 H. P.

Foundry contracts solicited for duplicate castings, from 10 lbs. to 5 tons each.



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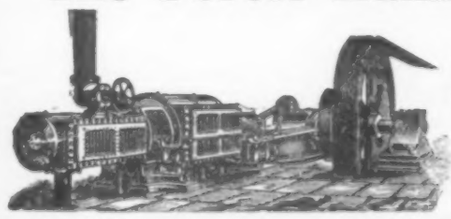
YOUNGSTOWN, OHIO.

The Porter-Hamilton Engine



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Williams Improved Vertical Engines

For Direct Electrical and all High Class Work.

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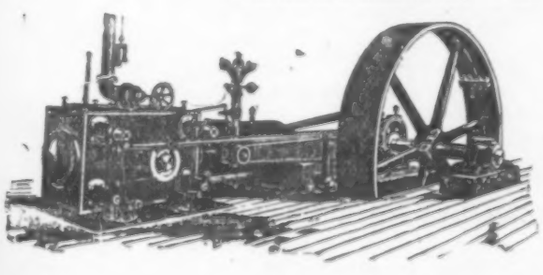
Park Building, Pittsburg, SEWARD S. BABBITT.

....The Rarig Engineering Company,
COLUMBUS, OHIO,



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Heavy Duty Corliss

BLOWING - STATIONARY HAULAGE - HOISTING - Engines.

Boilers, Tanks, Steel Chimneys Structural Iron Work.

1⅛ to 1⅜,	"	19 and 20	per 100 lbs.
1⅛ to 1⅜,	"	21	.20 "
1⅛ to 1⅜,	"	22	.30 "
15-16 and 1,	"	13, 14 and 15	.10 "
15-16 and 1,	"	16, 17 and 18	.15 "
15-16 and 1,	"	19 and 20	.20 "
15-16 and 1,	"	21	.25 "
15-16 and 1,	"	22	.35 "
⅞, Nos. 13, 14 and 15			.20 "
⅞, " 16, 17 and 18			.25 "
⅞, " 19 and 20			.30 "
⅞, " 21			.35 "
⅞, " 22			.45 "
¾ and 13-16 Nos. 13, 14 and 15			.30 "
¾ and 13-16 " 16, 17 and 18			.35 "
¾ and 13-16 " 19 and 20			.40 "
¾ and 13-16 " 21			.45 "
¾ and 13-16 " 22			.50 "
¾ and 13-16 " 23			.60 "
11-16, Nos. 13, 14 and 15			.35 "
11-16, " 16, 17 and 18			.40 "
11-16, " 19 and 20			.50 "
11-16, " 21			.60 "
11-16, " 22			.70 "
11-16, " 23			.80 "
⅝, Nos. 13, 14 and 15			.40 "
⅝, " 16, 17 and 18			.45 "
⅝, " 19 and 20			.55 "
⅝, " 21			.65 "
⅝, " 22			.75 "
⅝, " 23			.85 "
9-16, " 13, 14 and 15			.45 "
9-16, " 16, 17 and 18			.50 "
9-16, " 19 and 20			.60 "
9-16, " 21			.70 "
9-16, " 22			.80 "
9-16, " 23			.90 "
½, " 13, 14 and 15			.55 "
½, " 16, 17 and 18			.60 "
½, " 19 and 20			.70 "
½, " 21			.80 "
½, " 22			.90 "
½, " 23			1.00 "
7-16, " 13, 14 and 15			.80 "
7-16, " 16, 17 and 18			.90 "
7-16, " 19 and 20			1.00 "
⅜, " 13, 14 and 15			1.00 "
⅜, " 16, 17 and 18			1.10 "
⅜, " 19 and 20			1.20 "

Sheet Iron.

No. 10	1 50
No. 12	1 70
No. 14	1 60
No. 15-17	1 75
No. 18	1 85
No. 20	2 00
No. 22-24	2
No. 25-26	2 20
No. 27	2 30

English Tool Steel.

Jessop's	15½c
Hobson's " Best "	15½c
" " Choice "	13c

Steel Boiler Plates—1-4 in. and Heavier.

Tank	1 35
Shell	1 45
Flange	1 55
Marine Flange	1 60
Fire Box	2 05

Above includes plates 90 inches wide.

90 to 96 in. wide	½c. lb. extra
96 to 100 in. wide	1c. "
100 to 104 in. wide	1½c. "
104 to 106 in. wide	special.

Flats.	cts. lbs.
2 to 9-16 in. wide by 2 to ½ thick	.08

Bessemer and O. H. Steel.

Bessemer Machinery	base price, 1 40
Open-hearth Tire	" 1 45
Open-hearth Spring	" 1 80
Sleigh Shoe	" 1 45
Toe Calk	" 1 90
Cutter Shoes, tapered and bent	" 1 60

American Cast Tool Steel.

ROUND, SQUARE, AND OCTAGON.	cts. lbs.
1 to 2 in. inclusive	.08
9-16 to ⅞ in. "	.08
7-16 to ¾ and 2¾ to 3 in.	.09
3⅛ to 4 in	.09½
⅜ to 11-16 and 4⅛	.10
½ to 6 in	10½
¾ to 9-32 and 6¾ to 7 in	.11
1 in	.13

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⅛, ⅝, 11-16 and ¾ inches diameter	3 00
Bridge ⅛, ⅝, 11-16 and ¾ inch diam	2 55

Wrought Pipe and Boiler Tubes.

Lap weld black, base, and 10 per cent	72
Butt " " " "	72
Lap " galv. " "	70
Butt " " " "	67
Boiler tubes 2¼" and smaller	72½
Boiler tubes 2¾" and larger	72
Casting screw and socket joint	dis. 50
Casing inserted joint	dis. 45

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Magnolia Anti-Friction Metal, 25 cts. per lb., f. o. b. New York or Chicago.
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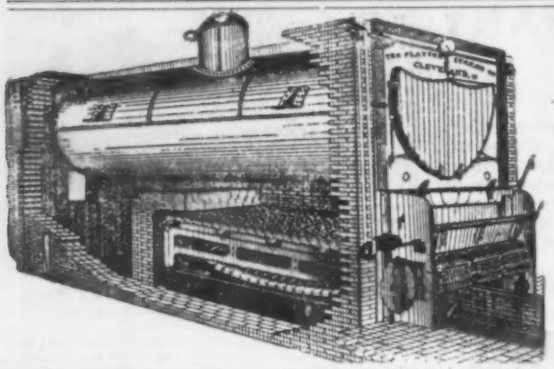
Mystic Metal, 10 cts. per lb., f. o. b. New York or Chicago.

Anvils.

American	@ lb 9@10
Wright's	@ lb 12

Bellows.

Blacksmiths'	Hill's dis
	Bullock's dis 50@11
Moulders'	dis 40@40&10
Hand	dis 40&10@50



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Published by

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Belting.

Boston Belting Co.'s standard.....dis 70 & 10
" " " extra.....dis 60&10
" " " best.....dis 55
Cleveland Rubber Co. extra standard.....dis 60&10
Hoyt's Short Lap.....dis 50
Shults Raw Hide Leather Belting, single.....dis 40
Munson's Short Lap Single Leather.....dis 50
Munson's Short Lap Double and Light Double Leather.....dis 50&10
Shults Raw Hide Leather Belting, Double and Light Double.....dis 40
Standard, oak tanned.....dis 50&10
Alexander Brothers' pure oak tanned.....dis

Blowers and Exhausters.

B. F. Sturtevant's.....dis 20
Boston Blower Co.....dis 35

Chucks.

Cushman's 4 Jaw Independent.....dis 45
" Combination.....dis 40
" Geared Scroll.....dis 80
" 2 Jaw Brass Workers.....dis 30
" Drill.....dis 35
Wescott's Scroll Combination.....dis 33⅓
" Independent.....dis 40
" Little Giant Drill.....dis 33⅓
Horton's Independent.....dis 45
Whiton's Independent.....dis 45
National Combination.....dis 45
Sweetland " .....dis 40
Almond Drill.....dis 40
Morse " .....dis 20
Skinner's Combination Lathe.....dis 40&15
" Independent Lathe.....dis 40&10
" Universal Lathe.....dis 40&10
" Drill.....dis 30

Cutters and Reamers.

Cleveland.....dis 10@15
Pratt & Whitney.....dis 10@15
Standard.....dis 10@15
Morse.....dis 10 to 15
Brown & Sharpe, Milling Cutters.....dis 15
" " Gear Cutters.....dis 15

Crowbars.

Cast Steel.....₩ 3½
Iron, steel points.....₩ lb 1

Drill and Drill Sockets.

Twist Drills
Morse Taper&Straight Shank to 1⅜"dis 50 &10 to 60
Morse Taper and Straight Shank Larger than 1¾".....dis 25
Drill Sockets.....dis 25
Standard Twist Drills.....dis 60@60&5
Cleveland " " .....dis 60@60&5

Emery.

	No. 4 to 46 gr.	No. 54 to 150 gr.	Flour, F. F
Kegs, ₩ lb	4½c	5 c	2½c
½ kegs ₩ lb	4¾c	5¼c	2¾c
¼ kegs ₩ lb	5 c	5½c	3 c
10 lb cans, 10 in case	6 c	6¼c	c
10 lb cans less than 10	10 c	10 c	¼c

Emery Cloth and Paper.

Barder, Adamson & Co.....dis 50@50&5
H. H. Barton.....dis 50@50&5

Emery Wheels.

Detroit.....dis 60@70
Norton's.....dis 60@70
Crant.....dis 60@70
Sterling.....dis 60@70
Celluloid.....dis 10&33⅓
Northampton.....dis 50
Crystal.....dis 65@70
Vitrified.....dis 60@70
Vulcanite.....dis 60&10
Hamden.....dis 60&10@70
Cyclone.....dis 60@60&10

Files.

Arcade.....dis 60&10@60&10&10
Nicholson.....dis 60&10@60&10&10
" X. F.....dis 25
Kearney & Foot.....dis 60&10@60&10&10
Black Diamond.....dis 60&10@60&10&10
McClellan.....dis 60&10@60&10&10
Disston's.....dis 65@70
Western.....dis 70
Stub's.....dis 25
Grobet's.....dis 50
Reynolds Bros.' Hand Cut.....dis 50
Industry File Works Hand Cut.....dis 50

Hammers.

P. S. W.....dis 40
Atha new list, Jan. 15, 1887.....dis 50
Heavy hammers and sledges under 5 lbs.....10c
" " " over 5 lbs.....8c

Jack Screws.

Illinois Bolt Co. list.....dis 75

Nuts and Washers.

Size of bolt inches	¼	5-16	⅜	½	⅝	¾	1
Square	8	7	5½	4¾	4	3½	3⅛
Hexagon	15⅝	11⅛	8½	6	5¼	5⅛	
Washers	9	8	7	5	4½	4⅛	4⅛

In lots less than 100 lbs, ₩ lb add ½c., 1 lb boxes add 1c to list.

Nails (wire).

Standard Penny Nails, ₩ keg, base.
{ Car lots.....$1.30
{ Less than car lots...$1.40

Oilers.

Zinc and Tin.....dis 60
Brass and Copper.....dis 50
Malleable (Hammer's), No. 1, $3.60; No. 2, $4.00; No. 3, $4.40 ₩ doz.....dis 10@10&15

Picks.

Railroads, 5 to 6 lbs.....dis $12 60
" 6 to 7 lbs.....dis $13 60

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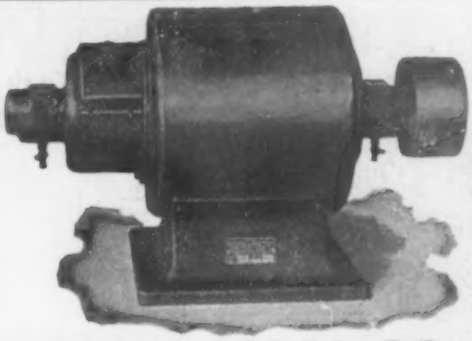
Storey Motors



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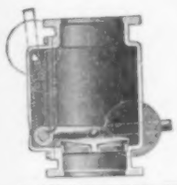

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Rivets.

Iron, Thousand, list November 1, 1894	dis 60@60
Iron, Ordinary, Cooper's Block and Carriage list November 1, 1894	dis 60@65
Copper	dis 50@50&15

Taps.

Cards, Hand and Nut to 2 in.	dis 50
Carpenters' " " "	dis 50
Morse " " "	dis 50
Pratt & Whitney " " new list	dis 10
Machine Screw Taps	dis 55
Pipe Taps to 2½ in.	dis 70
Stay Bolt Taps	dis 25
Stove Bolt Taps	dis 55
Pulley Taps	dis 40

Vises.

Solid Box	dis 60
Parker's	dis 20@25
Prentiss	dis 20
Stephen's	dis 25@30
Barrett's	dis 30
Miller's Falls	dis 40
Merrill's	dis 15@20
Howard	dis 35

Wire.

List, Apr. 9, 1894

Brass	dis 33⅓
Copper	dis 35c
Bright and annealed, Nos. 0@18	dis 70&10@75
" " Nos. 19@26	dis 75@75& 5
" " Nos. 27@36	dis 75&10& 5
Coppered Nos. 0 to 18, market list	dis 70@70& 5
Galvanized Nos. 0 to 18 " "	dis65& 5
Tinned market Nos. 0 to 18	dis 67½
Cast steel	dis 50
Tinned Broom Wire	dis 70&5@70&10
Annealed Fence, Nos. 8 and 9	dis 75
Annealed Grape, Nos. 10 to 14	dis 75
Stub's Steel Wire regular	95c ₩ lb dis 30

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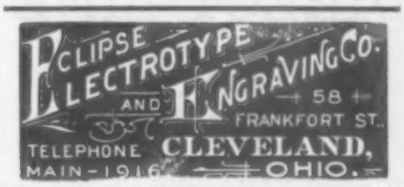

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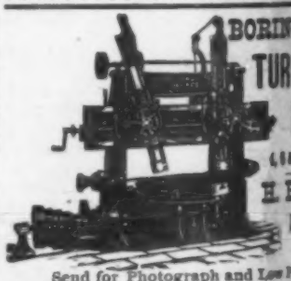

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